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CARCINOMA OF THE COLON

Analysis of 113 Cases

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CARCINOMA of the colon is of importance to the medical practitioner because of its frequency and because of the relative ease with which the diagnosis can be made and its relatively good prognosis. The colon is one of the most frequent sites of cancer in the body. In a series of 70,000 necropsies studied by Azeman, Maydl, Muehler, and Nothnagel[1], in which carcinoma was the cause of death in 5,796 instances, approximately one-fourth were located in the intestinal tract, 511 were found in the colon, of which 262 (51 per cent) were in the rectum. In a series of 335 cases reported by Cattell[2] 208 (60.1 per cent) were in the rectum and rectosigmoid and 127 (37.9 per cent) were in the colon, including the sigmoid flexure. The right colon was involved in 43 (12.8 per cent), the transverse colon in 17 (5.1 per cent), the splenic flexure and descending colon in 22 (6.5 per cent), the sigmoid and rectosigmoid in 117 (34.9 per cent) and the rectum and anus in 136 (40.5 per cent). In a series of 113 cases of carcinoma observed in the Ochsner Clinic in the 4 years from its opening, Jan. 1, 1942, to Jan. 1, 1946, the right colon was involved in 22 (19.5 per cent), the left colon in 42 (37.1 per cent) and the rectosigmoid and rectum in 49 (43.3 per cent). The cecum was involved in 10 (8.8 per cent), the ascending colon and hepatic flexure in 7 (7.9 per cent), the transverse colon in 5 (4.4 per cent), the splenic flexure and descending colon in 12 (10.6 per cent), the sigmoid in 28 (24.3) per cent, the

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rectosigmoid in 19 (16.7 per cent) and the rectum in 30 (26.5 per cent).

The etiology of colonic carcinoma, as in carcinoma elsewhere, is not known except that in many instances the malignant neoplasm originates in solitary or multiple polypi. Whereas there is no unanimity of opinion among surgeons and pathologists concerning the relative number of colonic malignancies originating in polypi, most are agreed that these lesions are potentially malignant, particularly the multiple congenital ones. *It is our belief that congenital polyposis is so definitely pre-malignant that carcinomatous change is prevented only by removal of the involved bowel or the relatively early death of the individual and that if the patient lives long enough the development of carcinoma is inevitable.* Dukes[3] found polypi in 75 per cent of 33 consecutive cases of cancer of the rectum and the sigmoid, the specimens being obtained at operation. Schmieden and Westhues[4] state that 60 per cent of all carcinomas of the colon and rectum arise from polyps. All polyps should be considered as premalignant and when detected should be removed before malignant change has occurred. Stasis at the flexures, which are relative points of fixation, are thought to be factors in producing malignant changes in these areas.

Pathology: Carcinomata of the colon and the rectum are adenocarcinomas and may vary considerably pathologically from a large, bulky, fungating mass, which is likely to be found in the cecum, to a relatively small cicatrizing lesion producing complete obstruction of the bowel, which is found most frequently in the left colon, particularly the sigmoid, or to a small polypoid tumor with no encroachment on the bowel lumen. A relatively infrequent type of rectal and colonic carcinoma is colloid adenocarcinoma in which there is an overproduction of gelatinous material. According to Hayes[5] 16 per cent of colonic carcinomas are of the colloid variety and they are usually found in the right side of the colon. Parham[6] found in a series of 72 cases involving the cecum and the ascending colon that 22 per cent were of the colloid variety. Of 265 involving the transverse colon, 7 per cent were of the colloid variety, whereas of 138 cases in the sigmoid flexure, only 4 per cent were of the colloid variety. Colloid carcinomas, although they occur infrequently, are of significance because they usually offer a relatively poor prognosis. As a matter of fact, gelatinous tumors of the rectum have been considered by Miles[7] as not being curable by any known means. This entirely pessimistic viewpoint is rarely justified, however, even though the prognosis is bad.

Recently considerable investigation has been done concerning the

lymphatic extension from malignant lesions of the colon and rectum. Gilchrist and David[8] showed that lymphatic involvement in these lesions is much more extensive than commonly considered. By employing a special technic in which the involved bowel and the lymph bearing areas were cleared according to the technic of Spalteholtz, they were able to demonstrate malignant involvement of a large number of lymph nodes. In a series of 22 specimens, between 8 and 48 lymph nodes were found in each by gross dissection. Following the clearing technic, 469 nodes were found in all the specimens, of which 111 contained carcinoma, but only 48 of these showed any gross change even in cross-section of the gland. The value of this method of examination is shown by the fact that there were metastases to the lymph nodes in 68 per cent of all specimens studied. Of the 22 which were studied grossly, there were 23.9 nodes per specimen as contrasted with 52.1 in the 25 cleared specimens. Of 32 specimens having metastasis, 18 had 4 or more nodes per specimen, 19 of the 32 node involvement at or above the bifurcation of the superior hemorrhoidal artery. The extent of metastasis was not dependent upon the duration of symptoms. In this series, 3 patients, with symptoms less than four months, had 22, 25, and 28 involved nodes, respectively, whereas 5 patients, who had symptoms from twelve to eighteen months, had none, 2, 3, 2, and 43 involved nodes respectively. The size of the tumor also had little influence on the number of nodes involved. Although the extension generally is upward, in cases in which there is blockage of the normal lymphatic drainage retrograde extension may occur. Tumors at the level of the levator ani have a double drainage, i.e., upward along the superior hemorrhoidal artery and also laterally along the superior surface of the levator ani muscle. Coller, Kay, McIntyre[9] made similar observations in 53 cases of carcinoma of the rectum which they studied, 64.2 per cent showed evidence of regional lymph node metastasis, there being an average of 67 nodes in each specimen. The same authors[10] found that in 46 cases of carcinoma of colon, exclusive of rectum, 28 (60.87 per cent) had regional lymph node metastasis, with an average of 52 nodes per specimen. There was an average of 59.4 nodes in the specimens in which there was nodal involvement and 41.4 in those without metastasis. Carcinoma of the right colon had nodal metastasis in 62.5 per cent, whereas those in the left colon had nodal metastasis in 60 per cent. These figures broken down are as follows: right colon, 28 cases, metastasis 14 (50 per cent); transverse colon, 15 cases, metastasis 6 (40 per cent); descending colon, 26 cases, metastasis 12 (46.2 per cent); sigmoid flexure, 51 cases, metastasis 15 (29.4 per cent). In addition to lymph node metastases, there

can be direct extension through the bowel, on beyond the bowel to the surrounding and adjacent structures. Hepatic metastases must always be considered because of the possibility of the tumor cells getting into the portal system and being carried through that system to the liver. In our series of 113 cases there was gross evidence of extension at the time of operation in 45 (39.8 per cent). In 7 (6.1 per cent) there was involvement of an adjacent viscus, such as bladder in rectal lesions, in 16 (14.1 per cent) there was regional lymph node metastasis and in 22 (19.4 per cent) there was regional lymph node metastasis and liver metastasis. Of the 45 cases with gross evidence of extension beyond the bowel in 15 per cent it was to adjacent viscera, in 35 per cent to the regional nodes and in 48.8 per cent to the regional nodes and to the liver.

The sexual relationship in large bowel carcinoma varies according to different statistics. In our 113 cases 52 (45.6 per cent) were males and 61 (54.4 per cent) were females. The disease is one of advancing age and whereas it has been known to occur in young persons its greatest incidence is in the fifth, sixth and seventh decades. In our series there were none in the first three decades. From 30 to 39 there were 13 (12.4 per cent); from 40 to 49 there were 23 (20.39 per cent); from 50 to 59 there were 33 (29.2 per cent); from 60 to 69 there were 32 (28.3 per cent), and from 70 to 79 there were 12 (10.6 per cent).

Symptoms and Signs: Malignant lesions of the colon because of alteration in function of the hollow viscus give rise to relatively early symptoms, although the manifestations vary considerably according to the type of lesion and its location. From the standpoint of function the two halves of the colon can be differentiated in that the right side is largely absorptive, whereas the left is mainly for storage. The contents of the right colon are fluid, whereas the contents of the left colon are solid. Because tumors of the right colon are bulky and fungating, but do not produce a great deal of narrowing of the lumen, obstipation is relatively infrequent. On the other hand, because left-sided lesions are usually cicatrizing, particularly those in the sigmoid, and because the contents of the left side of the colon are inspissated, constipation is a relatively early manifestation. Disturbances in bowel habits, such as the patient becoming conscious of his rectum, may be the earliest manifestation of a lesion in the rectum or rectosigmoid. The passage of blood and mucus, which is tell-tale evidence of an abnormality of the lower intestinal tract, always requires investigation. An unexplained anemia, in an individual who otherwise is well and who has no symptoms, may be caused by a fungating, ulcerating tumor

in the cecum. The anemia in such an instance may be so severe as to simulate a severe primary anemia. Recurrent attacks of constipation and diarrhea may be the result of many lesions, but are always suggestive of an obstructive lesion in the lower bowel, the constipation being the result of the stenosing effect of the neoplasm, and the diarrhea occurring because of liquefaction of the intestinal contents above the point of obstruction resulting from increased secretion from the irritated bowel and putrefaction of the intestinal contents. The complaint of hemorrhoids or any other rectal disorder requires thorough investigation, because most rectal carcinomas have associated hemorrhoids, and to treat an individual with such a complaint without a careful proctologic and sigmoidoscopic examination is fraught with danger. This cannot be over emphasized because every year we see from six to eight patients with rectal carcinoma who have been treated for hemorrhoids for varying periods of time without even a digital examination of the rectum having been made! Until the profession realizes that in ALL rectal complaints a malignancy must be considered first, many cases are going to continue to become inoperable.

The chief complaints in our series of cases were as follows: bleeding, 44 (38.9 per cent); pain, 30 (26.5 per cent); obstruction 25 (22.1 per cent); constipation and change in bowel habits, 23 (20.3 per cent); weakness, 5 (4.4 per cent); and abdominal mass, 3 (2.6 per cent). Three patients (2.6 per cent) had known they had carcinomas of the bowel for from 1½ to 3 years! In one, the family was told by a surgeon(?) that because of the patient's age (71) nothing should be done because he would probably die a natural death before his cancer killed him!!! Three years later, we successfully operated upon him and removed an obstructing lesion of the sigmoid! In our 25 known fatalities the symptoms varied from 1 month to 5 years. The duration of symptoms varied as follows: 1 to 3 months, 2 (8 per cent); 3 to 6 months, 4 (16 per cent); 6 to 9 months, 7 (28 per cent); 9 to 12 months, 2 (8 per cent); 12 to 18 months, 5 (20 per cent); 18 to 24 months, 3 (12 per cent); 4 years, 1 (4 per cent); 5 years, 1 (4 per cent). Twenty-four per cent had symptoms of 6 months or less and 60 per cent had symptoms of a year or less. It is interesting that in Cattell's[2] cases, 60.7 per cent had symptoms a year or less but 38.4 per cent had symptoms 6 months or less.

The diagnosis of colonic and rectal lesions is relatively easy and extremely exact. Since most rectal lesions are within the last six centimeters of the anus, these lesions can be detected usually by the examining finger. By means of proctoscopy or sigmoidoscopy, it is

possible not only to visualize lesions in the rectum and sigmoid but also to obtain biopsies of the tumors. Careful proctoscopic and sigmoidoscopic examination after meticulous preparation of the lower bowel is imperative in all persons having symptoms referable to the lower intestinal tract. Careful preparation, particularly with catharsis and enemas, is essential, however, in order not to overlook small lesions. Roentgenography is of little value in low-lying lesions and a negative x-ray in such a case in no way precludes the possibility of a malignant tumor in the rectum. On the other hand, roentgenography is invaluable in those lesions which are in the sigmoid or above. Fluoroscopic visualization of the filling of the bowel is essential. Small lesions such as polypi may not be detected until a double contrast roentgenogram is obtained, which is made possible by distention of the bowel with air after evacuation of the barium. This procedure is important in all patients with carcinoma because of the possibility of the existence of other lesions higher up, even though it be a benign tumor, such as a polyp. It is our belief that all patients with colonic and rectal carcinoma should have double contrast studies, in addition to the ordinary roentgenogram following a barium enema.

In spite of the relative ease and the comparative accuracy with which rectal and colonic lesions can be diagnosed, these cases are still seen relatively late after the patients have had symptoms for months and even years. Many times this is the fault of the patient for not having consulted a physician earlier. Too frequently, however, it is because the physician has disregarded the importance of the symptoms and minimized these manifestations. All too frequently the patient is told that the bleeding which he is having from his rectum is caused by hemorrhoids, and he is given a salve or ointment to correct this condition. Occasionally, the possibility of a neoplastic lesion is considered, but it is missed on proctoscopic or roentgenographic examination because of inadequate preparation. We have recently had a tragic example of this. A man who had had symptoms for over a year, had been examined by a competent radiologist approximately six months before we saw him. There was no preparation of the bowel before the examination, however. His symptoms continued in spite of the negative findings and assurance that he had no lesion of the bowel. At the time of our examination, which was preceded by a careful cleansing of the bowel, a mural lesion was found in the sigmoid. This was verified by operation, but unfortunately hepatic metastases had already occurred.

The treatment of rectal and colonic malignancies might be divided into two types, the preventive and the curative. Since many,

if not the majority of, colonic malignancies begin as benign polyps, the recognition of these benign lesions and their complete removal will prevent the development of a cancer. The history of bleeding from the bowel should make one suspect the possibility of a polyp and double contrast roentgenographic examination should be made to detect such lesions. If the polyp is located in the rectum, below the peritoneal reflection, it can be removed through the proctoscope, taking care to biopsy the base and to cauterize it completely. Those lesions which are located above the reflection of the pelvic peritoneum should be operated upon transabdominally and the polyp removed.

The curative treatment of colonic and rectal malignancies consists of complete removal of the involved segment of bowel together with the possible sites of extension, both the direct and the lymphatic. Wangensteen[11] suggested recently that in cases with hepatic metastasis, even partial hepatectomy might be done. Although this procedure might be considered possible from an investigative standpoint, it hardly seems reasonable to expect that a partial hepatectomy with the removal of the obvious metastatic mass is likely to result in a cure in many instances. Wide resection of the adjacent tissues and wide removal of the bowel, both proximal and distal to the lesion, is imperative because of the extension through the intramural lymphatics and direct peripheral extension in the wall of the bowel beyond the site of obvious gross involvement.

Preoperative Preparation: Much has been accomplished within the past decade in the treatment of large bowel malignancies by the careful preoperative preparation of the patient. In the presence of obstruction, decompressive procedures must be done as early as possible because, as shown by Wangensteen[12] cecal rupture can occur. Since obstruction occurs more frequently on the left side, a decompressive cecostomy is frequently a life-saving procedure and should be done early in those cases in which there is a high grade obstruction. If this is not done, the danger of perforation of the cecum, which is the most vulnerable site in a colonic obstruction, is considerable. After the performance of a decompressive cecostomy or colostomy sufficient time must be allowed to elapse for the acute inflammation to subside and for the gut to regain its tone before any resection of the involved segment is attempted.

After the relief of acute obstruction, it is important to re-establish the normal nutritional status. The bowel is emptied by means of small doses of a saline cathartic. It is our routine to administer a dram of magnesium sulphate every hour for six doses, which will cause evacuation of a large number of small fluid stools and can be

used even in partial obstruction. Following this, the patient is hydrated by giving large amounts of fluid, including fruit drinks. A non-residue diet rich in protein is administered to the patient in order to minimize the fecal content and to increase the glycogen content of the liver. The protein content of the diet can be increased greatly by the administration of essamine which is palatable and easily tolerated by most patients. This is a lactalbumin derivative containing 12.62 per cent of protein consisting of ten amino acids. It is administered in milk, orange juice, tomato juice, broth, jello, cereals or muffins. One hundred and fifty to 300 grams of protein can be given each 24 hours. Since many of these patients have lost weight and have been ill for some time, they are likely to have a contracted blood volume with resulting hemoconcentration, as demonstrated by Champ Lyons. The ordinary blood studies, such as red and white cell count, hemoglobin and plasma protein determinations give false values, because they do not represent the amount of the total circulating blood constituents. At the present time, we do blood volume determinations, and to those patients in whom there is a contracted blood volume we give transfusions of whole blood. Many of these patients will have low hematocrit values although the erythrocyte count and hemoglobin may be within normal limits. Until the actual anemia, especially the hemoglobin deficiency, has been corrected there will be little or no gain in weight and increase in plasma proteins, because of the preferential demand on protein for the synthesis of hemoglobin. They should be given sufficient whole blood to reestablish the normal levels of cellular elements, hemoglobin and protein, before operation is contemplated.

For the past four or five years we have been using sulfonamides in the preparation of these patients, having used sulfasuxidine mostly, but at the present time are using sulfathaladine. Neither of these substances is absorbed readily from the intestinal tract, and the latter is effective when given in relatively small amounts. Although we use sulfathaladine routinely, we feel that it is not a substitute for good surgery and in no way should permit sloppy surgery because of the possibility of a relatively sterile intestinal tract.

It is our belief that, whenever possible, the operative procedure and anastomosis, when such is done, should be done aseptically. In performing abdominoperineal resections, the operation is performed almost entirely aseptically, because the bowel is divided by means of the actual cautery between crushing clamps. The clamp on the proximal end of the distal bowel is small enough so that it can be shoved down in the hollow of the sacrum together with the mobilized sigmoid and rectum without any contamination. The

obstructive resection, of course, is done aseptically, and, also, we feel that it is desirable when possible to perform a "septic" anastomosis when a primary anastomosis is made. Coller and Vaughn[18] in a series of 116 cases of colonic carcinoma in which resections and primary anastomoses were done, 67 (57.8 per cent) were done aseptically and 49 (42.2 per cent) were performed as open anastomoses. The average hospital stay for cases with closed end-to-end anastomoses was 16.3 days, whereas that in the cases with open anastomosis was 26.7 days. In our series a resection with primary end-to-end anastomosis was performed in 27 cases of which 17 (62.9 per cent) were done aseptically, and in 10 (37.1 per cent) an open anastomosis was used. The frequency of closed or aseptic anastomosis is increasing in our clinic, although we feel that open anastomosis can be done without a great deal of contamination.

As an anesthetic we usually prefer spinal and have used it with very few exceptions in the present series. One may employ either a longer acting anesthetic agent, such as pontocaine or nupercaine, or continuous spinal. In the case in which there is some question concerning the resectability or operability, continuous spinal probably is to be preferred because in this way it is not necessary to use a long-acting drug if the case proves to be inoperable. In our series spinal was used in 109 cases (96.4 per cent). In two of these it was necessary to supplement with general anesthesia. Of the remaining 107 spinal anesthesia, which was satisfactory, was used. In 34 cases continuous spinal was used. One case was operated on under local, and in 3 general anesthesia was used.

The incision used for right-sided lesions is either a long paramedian or a transverse incision. A transverse incision is used for lesions of the transverse colon, the splenic flexure and the descending colon. The incision for rectosigmoidal and rectal lesions is a left paramedian one, which permits a better access to the pelvis. The type of lesion depends obviously upon the location of the lesion. In all right-sided lesions, a right colectomy is done. Unless there is a great deal of inflammatory reaction with fixation of the tumor to the abdominal parietes, a one-stage resection of the right colon is preferable. Coller and Vaughn[18] in a series of 60 cases with right-sided malignancies of the bowel were able to resect 47, in 6 of which a one-stage right colectomy was done, in 40 there was a two-stage right colectomy and in one an obstructive resection. In 15 cases of our series, a one-stage right colectomy was done in 12 (80 per cent) and a two-stage resection in 3. In the one-stage procedure, resection of the right colon is followed by an end-to-side ileotransverse colostomy, whereas in a two-stage resection, the ileotrans-

verse colostomy is done as a preliminary procedure and later the right colon is removed.

Lesions of the transverse colon, the splenic flexure, descending colon, and sigmoid are treated by resection with end-to-end anastomosis or by obstructive resection. The primary suture with end-to-end anastomosis, performed preferably using the aseptic technic, is better than obstructive resection because of the shortening of the convalescence and because of the more complete removal of the bowel and its mesentery. Coller and Vaughn[13] found that the average postoperative hospital stay following resection of the colon with closed anastomosis was 16.3 days, with open anastomosis, 26.7 days and with obstructive resection was 60.9 days. In 42 of our cases an end-to-end anastomosis with colonic resection was done in 27 (64.4 per cent) and an obstructive resection in 15 (35.5 per cent). Of the resections with end-to-end anastomosis, an aseptic technic was used in 17 and an open anastomosis in 10.

Whereas we resect and reestablish the continuity of the bowel in sigmoidal lesions with the exception of those at or near the rectosigmoidal junction, we believe that this procedure is not justified in the low-lying lesions, as has been advocated by Dixon,[14] Wangensteen,[11] Waugh and Custer,[15] Babcock and Bacon,[16] and we have used it in only one patient in whom a primary anastomosis was done for a rectosigmoidal lesion. This patient (#29175), a 65 year old male, gave a history of constipation for 30 years. For 5 or 6 years he had noticed bright red blood in the stool. Proctoscopic examination revealed a carcinoma at the level of the rectosigmoid, 10 cm. from the anal margin. An abdominoperineal resection was advised but was refused and, because of this, but contrary to our better judgment, a resection of the lower sigmoid and upper rectum, with primary anastomosis, was done on Dec. 13, 1944. Metastases were found in the regional lymph nodes. Postoperatively, there was evidence of localized peritonitis which responded well to transfusions, penicillin, and sulfadiazine. Because of urinary difficulty, a transuretheral prostatectomy had to be done during his convalescence. On Feb. 8, 1945, patient reported for a routine check-up and seemed to be in good condition. On July 26, the patient returned for another check-up. At this time a small papilloma, 3 mm. in diameter, visualized proctoscopically 12 cm. from the anal margin, was removed and the base cauterized. On Nov. 28, the patient returned and proctoscopy revealed evidence of local recurrence in the region of the anastomosis, and at operation a frozen pelvis, due to extension of the lesion to the sacrum, the left ureter and the great vessels, was found. Resection was impossible. Patient died Jan. 4, 1946.

The present enthusiasm for resection of the lower sigmoid and rectum, with reestablishment of the continuity of the bowel, is apparently based upon the investigations of Gilchrist and David[8] and Coller, Kay and McIntyre,[9] as evidenced by a statement made by Waugh and Custer[15]—"Supported by the pathologic evidence furnished by Gilchrist and David and further extended by unpublished work of Glover, the curable malignant lesions of the lower part of the large bowel, seldom, if ever, metastasize in a retrograde manner. Various surgeons have contrived procedures both to cure the disease and to preserve the sphincter." It is interesting in view of this statement to review Gilchrist and David's original publication. Whereas they conclude that low-lying tumors may metastasize high, they also emphasize that if the upward channels are blocked by metastases retrograde metastases can and do occur. They also stress that in those instances in which the tumor is at the level of the levator ani muscle, the danger of extension laterally is considerable. In such an instance, wide resection of the levator ani is necessary. They state, *"Radical removal with resection of the superior hemorrhoidal artery as high as possible and wide resection of the levator ani muscles is necessary in order to give the best chance of permanent cure,"* and they conclude, "A Miles' type of operation seems the ideal one from the standpoint of wide removal of lymphatic node bearing area." It is interesting that, although Gilchrist and David emphasize that the Miles' operation is necessary to eradicate rectosigmoidal and rectal lesions, their investigations should be the basis for the reconstructive procedure. Wangensteen,[11] who is an ardent advocate of this procedure, in a recent publication reports 24 cases in which the procedure was done for cancer of the rectum, of which 22 survived. Of the 22 survivals, 5 had evidence of local recurrence in from six months to three years. Even though in 4 of these the ampullary resection was done as a palliative procedure, the fact that 22 per cent had recurrence within three years is evidence that the procedure is not a good one as regards the cure of carcinoma. Wangensteen, in commenting on his cases, states: "Whereas Coller and his associates fail to find evidence of lateral lymphatic spread in lesions lying more than 3 cm. above the anorectal line, I am convinced from the experience with low-lying fixed lesions that an operation which does not excise the levator muscles in juxtaposition to the bowel invites local recurrence. In the 5 instances reported herein in which local recurrence followed ampullary resection, the local invasive qualities of the tumor may have been responsible, yet I believe it would be safer to suggest that ampullary resection in such instances can be indicted on the score of failing to remove the lateral zone of lymphatic spread as well as in its failure

to deal adequately with the item of local invasion. Miles states that the levator ani muscles are especially prone to invasion by cancer cells, which have gained access to the extramural lymphatic system of the rectum."

Lahey[17] succinctly states that the indication for the resection and anastomosis of low-lying lesions is dependent upon a sentiment for the anal sphincter. Although we believe that no one would want to sacrifice the anal sphincter unnecessarily, the value of its preservation can hardly be compared with the preservation of life, if, by attempting to retain the sphincter, there is a compromise in the removal of the carcinoma. Whereas an anastomosis following resection in these cases is permissible in the individual with distant metastases because in such an instance a fatality is inevitable and the danger of local recurrence, because of inadequate removal of the neoplasm, is not significant, in the patient whose lesion is still limited to the bowel, its immediate environs and the regional lymph nodes, any procedure which does not completely remove all of the neoplastic tissue is a dangerous one. In our series this procedure was done in one instance, because the patient insisted upon not having a colostomy. Fortunately, it was the first case in which the conservative procedure was done and, even though we believe that a fatality occurred unnecessarily in this case, it is our opinion that had an abdominoperineal resection been done originally, the man probably would have been cured. No further needless sacrifice of life is likely to occur as the result of our efforts because in low-lying rectosigmoidal and rectal malignancies abdominoperineal resections will be done. Many persons undoubtedly abhor a colostomy. This is probably due to several factors: first, their knowledge of colostomy is based upon information of a few patients who have had trouble with their colostomies. Such is likely to occur in an individual with a colostomy whose primary lesion has not been resected and in whom the colostomy was done as a palliative procedure. On the other hand, a patient whose primary lesion has been completely removed can, with very few exceptions, be taught to control his colostomy without any difficulty. By the use of a constipating diet and the regular evacuation of the bowel, by means of an enema every forty-eight to seventy-two hours, he is able to carry on without any difficulty or embarrassment. The care of the colostomy, necessitating the taking of an enema every two to three days, is a relatively cheap price to pay for the cure of a malignant disease, as contrasted with the price of a few months' to a year's normal sphincteric control to be paid for with one's life. That resection of low-lying lesions can be done relatively safely with present day technic is

evidenced by the statistics of Waugh and Custer,[15] who reported a group of 16 cases with a 6.3 per cent mortality. The immediate mortality, of course, is only a part of the picture. It is the subsequent incidence of recurrence and mortality with which we are most concerned, because simply to operate upon a patient without a fatality is not the desideratum, but instead it should be the complete removal of the neoplastic lesion, and ultimate cure of the patient.

As evidenced by the investigations of Gilchrist[8] and Coller et al,[9] wide resection of the mesentery and the lymph-bearing area is essential. High ligation of the superior hemorrhoidal vessels and removal of the accompanying lymph nodes is necessary in rectosigmoidal and rectal lesions. In our series of 113 cases there was gross evidence of extension in 45 (39.8 per cent). In 7 of these (6.1 per cent) there was direct extension to adjacent viscera, in 16 (14.1 per cent) there were metastases to the regional lymph nodes, and in another 22 (19.4 per cent) there were metastases to the regional lymph nodes and to the liver. Of the 45 in which there was extension beyond the local lesion, 48.8 per cent involved the regional lymph nodes and the liver, 35.5 per cent the regional lymph nodes alone, and 15.7 per cent showed local extension to adjacent viscera or structures. Carcinoma of the bowel is relatively slow growing and in 103 of our cases in which the tumor was graded according to Broder's Classification it was as follows: Grade I, 12.6 per cent; Grade II, 51.4 per cent; Grade III, 33.8 per cent; and Grade IV, 1.9 per cent. The results when graded according to both Broder's and Duke's classification were as follows:

Adeno	Ca	Grade	II	Duke's	C - 45
"	"	"	III	"	C - 34
"	"	"	I	"	A - 6
"	"	"	IV	"	C - 2
"	"	"	II	"	B - 2
"	"	"	I	"	B - 3
"	"	"	I	"	C - 2
Colloid	"	"	II	"	C - 6
"	"	"	I	"	C - 2
"	"	"	III	"	C - 1

Although the diagnosis of rectal and colonic lesions can be made relatively early, unfortunately, as evidenced by these findings concerning extension beyond the local confines of the bowel, the diagnosis is frequently made late, which might preclude resectability. In our series, there were 22 cases in which the right colon was involved, of which 18 (81.8 per cent) were resectable and 4 were not.

Coller and Vaughn[13] report a resectability of 78.3 per cent in these lesions. The left colon, including the sigmoid, was involved in 40 cases, of which 26 (65 per cent) were resectable and 14 were not. The rectum and rectosigmoid were involved in 51 instances, of which 43 (84.3 per cent) were resectable and 8 were not. In the entire group of 113 cases, 96 resections were done (84.8 per cent). Nine of these were palliative resections (7.9 per cent), the lesion being removed even though there was evidence of metastasis in the liver, and in 87 (76.9 per cent), curative resection was done since there was no evidence of distant metastases. In 10 (8.8 per cent) a palliative colostomy was done, in 5 (4.4 per cent) a palliative short-circuiting procedure was done, and in 2 (1.7 per cent) only an exploratory laparotomy was done.

Of 113 cases, an abdominoperineal resection was done in 41 (36.2 per cent). Of 51 cases with lesions in the rectum and rectosigmoid 43 were resectable, and in these an abdominoperineal resection was done in 41 (95 per cent). Coller and Ransom[18] did abdominoperineal resections in 96 per cent of their rectal lesions. In 27 (23 per cent) of our 113 cases a primary resection and end-to-end anastomosis was done. Of these, 17 (14.2 per cent) were done aseptically and 10 (8.89 per cent) had open anastomoses. Fifteen (13.2 per cent) had an obstructive resection. In 15 (13.2 per cent) a right colectomy and an ileotransverse colostomy were done. Of these 12 (10.6 per cent) were done in one-stage and 3 (2.6 per cent) in two-stages. In 2 cases a total colectomy was done. In both of these a preliminary abdominoperineal resection was done for a carcinoma involving the rectosigmoid, which was followed later by a total colectomy because of a multiple polyposis, the carcinoma being the result of malignant change of a polyp. Multiple malignant lesions were found in other polypi following the total colectomy. In one instance of anal carcinoma a posterior resection was done (0.8 per cent). This was performed with the idea that it was a palliative resection, but the patient has remained well for approximately 4 years.

Of the 113 cases of rectal and colonic carcinoma, 105 (92.8 per cent) left the hospital alive, whereas 8 (7.1 per cent) died in the hospital. Four of these deaths occurred in individuals in whom palliative procedures had been done. Two had palliative cecostomies (decompressive procedures), one a palliative colostomy (decompressive procedure), and one a palliative iliosigmoidostomy (short-circuiting procedure) for an extensive lesion involving the descending colon.

No. 15282. Mrs. L. B., aged 70. Obstructive carcinoma involving the ascending colon. Aug. 23, 1943, cecostomy. Patient became worse in spite of cecostomy and died August 26. Autopsy showed generalized carcinomatosis, metastasis to the liver, peribronchial nodes in lung, in addition to pulmonary edema and bronchial pneumonia.

No. 16706. Mrs. S. H., aged 54. Acute obstruction apparently due to carcinoma of the sigmoid. Sept. 20, 1943, palliative cecostomy. Generalized carcinomatosis. Improved somewhat. Died Oct. 5, 1943. Cause unknown—autopsy not permitted.

No. 20608. Mrs. F. E. T., aged 60. Obstruction of descending colon. Feb. 28, 1944, transverse colostomy. Postoperative course stormy. Died March 7. Autopsy showed general carcinomatosis, terminal bronchial pneumonia, abscess of the left flank originating at site of tumor.

No. 18117. Mrs. T. G., aged 45. Obstructive manifestations apparently due to tumor of sigmoid. Nov. 24, 1943, ileosigmoidostomy. Postoperative course satisfactory. Died Dec. 8, 1943. Autopsy showed extensive carcinomatosis involving descending colon and left half of the transverse colon; bronchial pneumonia.

Of the 96 patients in whom a resection could be done, a palliative procedure was done in 9, the local lesion and regional metastases were removed but the hepatic metastases were left undisturbed, and a curative resection was done in 87, none of which showed evidence of distant metastases to the liver. In the latter group of "curative" resection there were 4 deaths (3.2 per cent).

Résumé of the 4 fatalities following resection:

No. 8852. P. M. S., female, aged 64. Poor general condition, but thought to be able to stand abdominoperineal resection for rectal carcinoma. Dec. 2, 1942, abdominoperineal resection. Left operating room in good condition. Postoperatively seemed to be in good condition, but late on day of operation became drowsy. Next day pulse was rapid and condition appeared critical. Blood pressure fell in spite of administration of blood. She became irrational. Respiration rapid. Expired on first postoperative day. Cause of death unknown—autopsy not permitted.

No. 28893. L. E. B., male, aged 60. Three years previously had had coronary occlusion. Dec. 8, 1944, abdominoperineal resection for carcinoma of the rectum. Postoperative progress satisfactory except for moderate distention. Was progressing nicely. On the tenth postoperative day, suddenly became cyanotic, dyspneic, and died within two hours. Autopsy showed multiple pulmonary infarction from mural thrombus, originating in left ventricle at the site of the previous coronary infarction. Extensive pneumonitis, cardiac failure. Death was apparently due to pulmonary infarction and not connected directly with the operative procedure.

No. 21699. B. L., female, aged 63. Abdominoperineal resection Apr. 7, 1944, for rectal carcinoma, under spinal analgesia. At about the close of the perineal portion of the procedure, the patient became pale and dyspneic.

Blood pressure at this time 110/70. Within two minutes she was dead, cause not being known. She received 500 mg. of procaine during the procedure and had received 700 c.c. of whole blood. It is presumed it was an anesthetic death. Autopsy not permitted.

No. 22797. Mrs. M. B., female, aged 68. Obstructive resection performed May 19, 1944, for a carcinoma of the sigmoid. Postoperative convalescence very satisfactory. On fifth postoperative day a crushing clamp was applied to the spur. There was no discomfort produced by this. She died very suddenly the following day, apparently without being ill. Autopsy showed nothing but postoperative atelectasis in the lower lobes of both lungs. There was no evidence of any embolism or thrombosis.

Of the 105 patients who left the hospital, 17 are known to be dead. The length of time that these cases have been followed is much too short for this to be a reliable figure and a number of years must elapse before a more reliable figure can be obtained.

The mortality rate following operation for cancer of the colon varies according to the location of the tumor. In 18 cases in which the right colon was removed for carcinoma there were no fatalities. In 30 cases in which a portion of the left colon was resected, 4 of which were done as palliative procedures and 26 as curative procedures, there were 2 deaths (6.6 per cent mortality), and in 48 cases in which rectosigmoidal resection was done, usually as an abdominoperineal resection, of which 5 were done as palliative procedures in spite of metastasis of the liver, there were 2 deaths (4.1 per cent).

Discussion

Although the results from the surgical treatment of malignant lesions of the large bowel are good at the present time, they can be much better if earlier diagnoses are made and surgical therapy instituted while the lesion is still confined to the bowel. The fact that a curative resection could be done in only 87 of our 113 cases (76.9 per cent) is proof that the condition is not being recognized early enough for an operative procedure to be undertaken at a time when the lesion still can be eradicated. Of the 26 in which a curative resection could not be done, there were 9 in which a palliative resection was done. Although there may be some question about the advisability of a palliative resection in malignant lesions of the colon and other viscera, this procedure seems perfectly justifiable to us, because not only is the patient relieved of the undesirable symptoms incident to an ulcerating tumor of the bowel, but it has been the experience of most surgeons that, following the removal of a primary tumor, the growth of metastatic lesions is less rapid than before the extirpation of the original tumor. We have one patient

who is living at the end of four years who at the time of operation had a nodule in the liver, and in whom a palliative resection was done. It is obvious that the patient will succumb to his carcinoma, but in the meantime he has been free from symptoms, and able to carry on a useful occupation. Although it is regrettable that only a palliative resection could be done in 9 cases, it is even more tragic that in 15 of the entire group (13 per cent), no resection was possible because of the extensive involvement of the tumor. In 10 of these, only a defunctioning colostomy was possible, in 5 a short-circuiting palliative procedure was done, and in only 2 an exploratory laparotomy was done.

Because of the accuracy with which a malignant lesion of the large bowel can be diagnosed, it is necessary that the medical profession take more cognizance of symptoms referable to the gastrointestinal tract and refrain from minimizing and disregarding symptoms which may be indicative of neoplastic lesions. It is far better to subject a patient to proctoscopic, sigmoidoscopic, and roentgenographic examinations than it is to assume that his symptoms are caused by hemorrhoids or some other benign condition. Probably the time will come when routine proctoscopic and roentgenographic examinations of the entire colon will be made in order to pick up premalignant lesions such as polypi. The possibility that the majority of malignant lesions of the bowel originate on the basis of a polypi would justify such an examination as a routine procedure. As emphasized above, it is not enough to perform a proctoscopic examination or to get an x-ray of the colon because, unless the patient is carefully prepared before these examinations are made, small lesions can be overlooked.

In our series of cases the resectability of lesions in the right colon and those of the rectosigmoid were approximately the same, 81.8 per cent and 84.3 per cent, respectively. On the other hand, lesions of the left colon, exclusive of the rectosigmoid and rectum, had a much lower incidence of resectability (65 per cent). The decrease in the resectability in lesions of the left colon is due to the fact that in this group of cases extension to the abdominal parietes was present in a much higher incidence, which many times precluded resectability. The attachment of a malignant lesion, however, to the abdominal parietes does not necessarily mean malignant involvement, or, even in the presence of obvious malignant involvement of the abdominal parietes, one need not necessarily be deterred from attempting a resection. In many instances fixation of the lesion to the parietes is due to an inflammatory process which will subside after decompression of the colon by cecostomy or proximal colos-

tomy. In many instances, it is possible, even though there is malignant involvement of the parietes, to do a wide resection of the abdominal wall. In one of our cases, a man of 74 was operated upon with extensive involvement of the anterior abdominal wall and also involvement of a loop of jejunum, necessitating a wide resection of the abdominal wall; almost the entire left colon, and a segment of jejunum. This patient had had a preliminary proximal colostomy done, and it was possible to resect the jejunum, do a primary aseptic anastomosis, and perform an anastomosis of the ends of the left colon. With some difficulty the abdominal wall was closed. Several weeks later the proximal colostomy was closed. This patient remained well for 3 years, and died of a coronary thrombosis with no apparent evidence of recurrence.

Although the patient with a malignant lesion of the large bowel may be debilitated, due to associated infection resulting from ulceration and from loss of blood, it is now possible to prepare him very satisfactorily. Any obstruction must be overcome before a resection is attempted. Of great importance in the preparation of these patients is the reestablishment of the normal blood volume, which is likely to be altered much more extensively than is ordinarily considered. Only by determination of blood volume in the chronically ill patient, who has lost weight, can one determine the total circulating red cell mass, the total circulating hemoglobin, and the total plasma proteins. The ordinary red cell and hemoglobin determinations are likely to give false values because of a contracted blood volume and associated hemoconcentration. The disturbances in blood volume and the decrease in hemoglobin can best be corrected by administration of whole blood, the amount required being much in excess of that usually used. Not infrequently, a patient who appears to be in fairly good condition will require as much as three or four liters of blood preoperatively. If this is done, relatively little difficulty will be experienced in the postoperative period.

Tumors of the large bowel are relatively slow growing and for this reason offer a good prognosis if extirpation can be done reasonably early. Of our cases, 64 per cent were of Grade I or Grade II and only 1.9 per cent were Grade IV. Although the majority of the tumors were of low-grade malignancy, most had existed for a relatively long time as evidenced by the grading according to Duke's Classification.[3] He suggests that carcinoma of the rectum be classified as follows: "A. Cases—those in which the carcinoma is limited to the wall of the rectum, there being no extension into the rectal tissues, and no metastasis to the lymph nodes. B. Cases are those in which the carcinoma has spread by direct continuity to the extra-

rectal tissue, but has not yet invaded the regional lymph nodes. C. Cases are those in which metastases are present in the regional lymph nodes." In 103 cases in which the classification was done, 92 (89 per cent) were classified as C and only 6 (5.8 per cent) were classified as A, indicating that the tumor was limited to the bowel. Five were classified as B.

As discussed above the curative treatment of malignant lesions of the colon consists of wide removal of the involved portion of the bowel and the possible sites of metastasis. There can be no compromise if no cure is to be accomplished. Although reestablishment of the continuity of the bowel in low-lying lesions has become quite popular, we believe that in any lesion except the extremely small ones in which there can be no extension distally, abdominoperineal resection is the operation of choice and that as long as attempts are made to preserve the sphincter the recurrence rate and death rate from carcinoma will continue to be high.

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PRACTICAL ASPECTS OF THE Rh FACTOR

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TO MANY of us the first news of a new clinically important factor in blood came as oblique and unexplained remarks in the infrequent bulletins and articles received overseas. Shortly after being reassigned to this country, a group of us returnees was vastly stimulated by a death in a nearby hospital following transfusion, that investigation proved to be due to Rh sensitivity.

The available papers on the subject were largely experimental reports and clinically were somewhat controversial. Conferences with a fellow officer who had worked with Landsteiner and Wiener after their important discovery yielded mostly minutiae and many interesting facts regarding ethnic mixtures and migrations provable by various studies on modern and ancient blood, but few clinical sea-anchors. Obviously, anything as important in the day by day life of the general surgeon must be mastered, must be reduced to working practicability. The first step in this aim should always be a lucid appreciation of the facts and theories that are basic.

The basic fact in this outstanding contribution to the prevention of certain transfusion reactions is that the four groups of human blood can be divided into two types by mixing the human cells with serum containing the specific immune agglutinin produced by Landsteiner and Wiener. Eighty-five per cent of samples of human blood will agglutinate in this serum; fifteen per cent will not. The former is designated as Rh positive blood and the latter as Rh negative. Under certain conditions, antibodies can be formed in Rh negative blood against this Rh factor. These antibodies are contained in the blood serum, are probably protein in nature and in the globulin fraction of the blood.

The Rh factor is about evenly divided between the sexes and between the four blood groups. It is transmitted in humans as a simple Mendelian dominant.

Anti Rh immune bodies may develop among Rh negative persons in two ways: either by repeated blood transfusions or during pregnancies. An individual that has been so sensitized may, on exposure to the antigen again, have a reaction that can be fatal. Deaths resulting from these reactions are anuric.

Apparently, iso-immunization occurs more frequently as a result of pregnancy than as a result of repeated transfusions. For this to occur, the prospective mother must be Rh negative, the father of

the child Rh positive, and the fetus Rh positive. Given this condition, there may be either an escape of fetal erythrocytes into the maternal circulation, or an exchange of Rh factor from the fetus to the mother with the resultant production of specific anti Rh immune bodies in the mother. This takes place from the second to the third month of gestation. The immune bodies may pass back to the fetus causing intrauterine death and miscarriage, or the child may be born near term with the condition of erythroblastosis fetalis in some degree. In a series of pregnancies the results may be progressively worse, the reverse of the condition in the case of a luetic mother. At the time of miscarriage or delivery the mother may suffer a severe hemorrhage or for other reasons a transfusion of blood may be amply indicated. The father is the handiest and most willing donor. Thus the trap is set. An infusion of his Rh positive blood will surely result in a very severe reaction and quite possibly in a most tragic death.

In the case of the child born alive from such a circumstance, hemolysis of its blood is the danger. This may vary from a very transient, moderate hemolysis to death very promptly. The onset may be in utero or occur some hours after birth. This active destructive process is symptomatically characterized by jaundice, dark urine, anemia, immature red cells, petechiae, brain and liver damage, and hyperplasia of the hematopoietic tissues. Transfusions are necessary in severe erythroblastosis to tide the patient over as long as active antibodies are in the circulation and proceeding about their destructive business. It has not been my misfortune to see such a case, once learning its cause, but there is little question that type O Rh negative blood should be used rather than blood from the mother or father.

It is not definitely known in any individual case how long after one or more transfusions of Rh positive blood into an Rh negative recipient antibodies persist or how quickly they form. Most investigators report that five days is the minimum time required to develop this sensitivity. Likewise, after a mild reaction all the antibodies may be united with Rh positive factor temporarily. With this in mind it has been recommended that transfusions may be given at from two to four day intervals with relative safety.

To play this menace safely and to take advantage of the additional safety afforded your patients by the understanding of its modus operandi, I suggest the following principles:

Never use a husband as a blood donor for a wife who is or has been pregnant.

Rh type all recipients. If they are Rh positive, Rh typing of donors may be dispensed with. If they are Rh negative, use only Rh negative donors.

Use group O Rh negative blood, other than the mother's, to transfuse babies with erythroblastosis fetalis.

THE DIFFERENTIAL DIAGNOSIS OF INTERVERTEBRAL CARTILAGE RUPTURES AND INTRASPINAL TUMORS WITHIN THE LUMBAR SACRAL CANAL

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THE increasing notoriety and popularity of the "ruptured disk" has served to focus diagnostic attention on the fact that radiating nerve root pain is more likely of mechanical origin than the result of so-called inflammatory or other intrinsic changes in the nerve structures. The "disk" possibility as a cause for the lumbago-sciatica syndrome has had its influence in bringing about earlier recognition of spinal cord tumors. The differential diagnosis in these two groups is by no means always easy. In the full-blown late developments of spinal cord tumor the diagnosis is not difficult and can be accurately made from a neurologic examination. With the history of a specific initiating low back trauma and a subsequent sciatica, a "disk" rupture is likely the accurate diagnosis, but such a case can be an intraspinal tumor within the lumbar spinal canal. In a large series of clinically diagnosed ruptured lumbar intervertebral cartilages that were incapacitated by their sciatic pain and in which conservative treatment had failed to relieve them, it was found that approximately 1 per cent of this group had intraspinal tumors. It was further learned from a study of clinically diagnosed tumors that a higher percentage had completely herniated, either a full annulus or a nucleus pulposus or both into the lumbar spinal canal, to produce a complete obstruction. It is these two groups, namely, the tumors diagnosed as disks and the disk cases suspected as being tumors, which form the basis for this communication.

The subjective symptomatology of these two groups of patients may serve to be very misleading in the clinical diagnosis. A history of a specific back sprain is to be elicited in approximately 85 per cent of the disk cases. If no specific traumatic insult, the character of the individual's work may be such as to necessitate laborious efforts and a series of minor insults results in a frank extrusion of the intervertebral cartilage. The history of antecedent incapacitating bouts of lumbago does not appear in the historical data of the tumor cases and a low back trauma history is very rare indeed, infrequent enough to be no more than coincidental. In the disk cases

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a specific back sprain is a frequent story, with complete disappearance of low back pain and recovery from the disability after a few days. In one-third of the disk cases such a story is common. In the tumor cases there is a frequent history of activities increasing the sciatica but no frank evidence that prolonged bed rest contributed to alleviation of this nerve root pain. As a matter of fact, in the

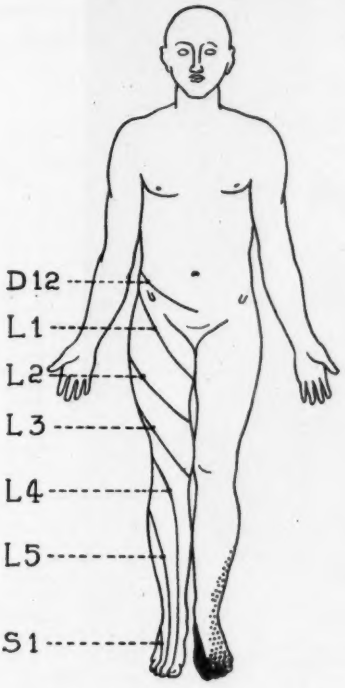


Fig. 1. The sensory changes in the disk cases subjectively are usually referable to specific toes and objectively if present are definitely segmental.

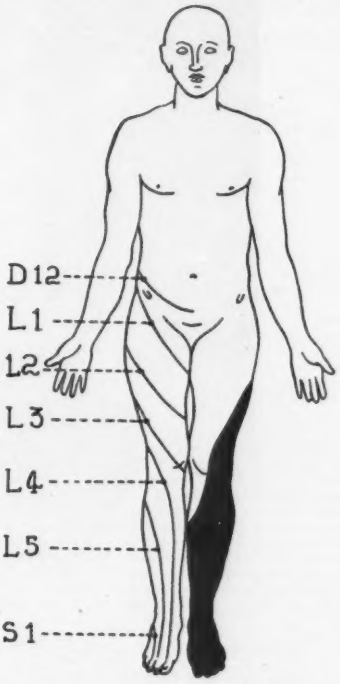
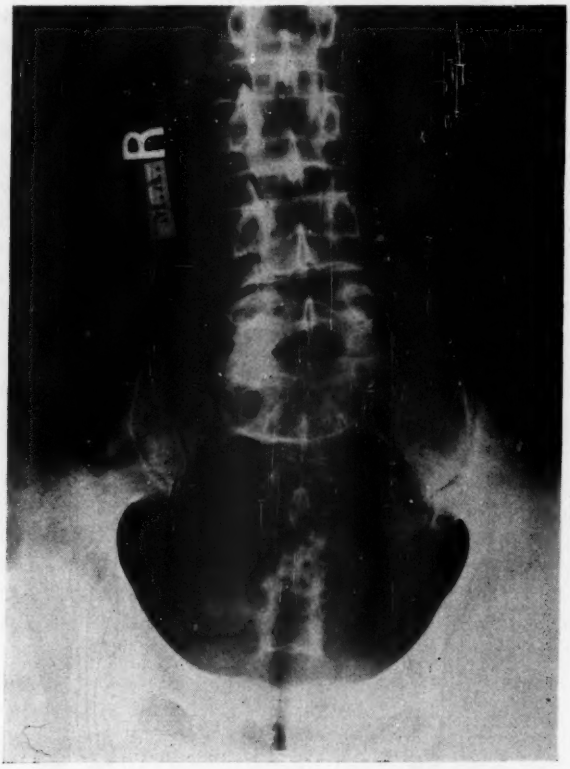


Fig. 2. Sensory patterns when present in tumor cases are clear cut organic in character.

spinal cord tumors there is a constant story that some activity resulted in relief of the symptoms of painful character. This is a well-known fact and before the common recognition of ruptured disks as a frequent cause of sciatica, neurologists and neurosurgeons alike frequently relied upon the statement that a patient who sought relief by "getting out of bed and walking about" might likely be the victim of a spinal cord tumor. There is, however, an occasional ruptured disk patient who is more comfortable sitting out of bed

or standing for a short period of time for relief. Rare is the incidence that walking nets any relief for these patients. One might as a general clinical rule say that "disk patients lie and tumor patients

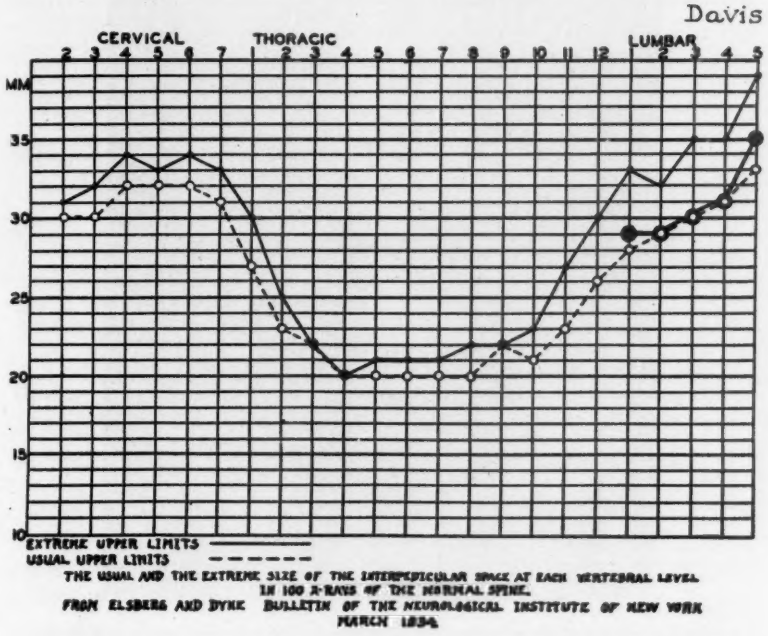


Figs. 3 & 4. The "sciatic list" in these cases is primarily a splinting mechanism resulting from muscle spasm and not essentially the space loss between the vertebral bodies. The interpedicular measurements in these cases fall within normal limits.

walk" for relief of their nerve root pressure symptoms. The pain of the ruptured disk is most often unilateral whereas the sciatica of tumor origin is likely to become bilateral in distribution. A rapidly developing bilateral sciatica, due to a disk, which develops symmetrically, is more likely to masquerade as a tumor suspect whereas unilateral posterior hip, thigh and calf distress with no low back pain or traumatic history may well be the earlier manifestations of tumor masquerading as a disk.

Intensification of sciatic pain on coughing and sneezing has been

stressed as an important clinical suspect of a ruptured disk. This occurs in a large number of tumor cases, particularly if the tumor is a neurofibroma arising from a nerve sheath of one of the lumbar or sacral nerve roots or a meningioma attached to the meninges of this lumbar or upper sacral sac. This is as it should be expected; the ruptured disks, while extradural, are just as space occupying as a benign tumor and any sudden congestion of the epidural varicosities or a mechanical shift upon the free spinal roots from spontaneously increased intraspinal pressure against the space occupying


Davis
CERVICAL
THORACIC
LUMBAR
2 3 4 5 6 7 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5
MM
35
30
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10
EXTREME UPPER LIMITS
USUAL UPPER LIMITS
THE USUAL AND THE EXTREME SIZE OF THE INTERPEDICULAR SPACE AT EACH VERTEBRAL LEVEL IN 100 X-RAYS OF THE NORMAL SPINE.
FROM ELSBERG AND DYKE. BULLETIN OF THE NEUROLOGICAL INSTITUTE OF NEW YORK MARCH 1934

FIG. 4

lesion might well produce subjective spinal nerve root symptoms. So, the phenomenon of intensification of symptoms from coughing, sneezing, straining acts, can only be ascribed as a mechanical influence on cerebrospinal dynamics physiologically altered and not a characteristic of a specific clinical lesion.

Activities that entail low back bending, whether this be forward or lateral, are more likely to intensify the symptoms of a disk patient than that of a tumor instance. Much more consistent in the disk cases is their sciatica, made more severe when bending to the ipsolateral painful side than to the opposite. Extreme forward bending

from an erect position is quite possible with a low lumbar tumor, but in a ruptured disk this will incur a "list" to the non-painful side and reproduce the patient's sciatica.

Figs. 5 & 6. A hemilaminectomy for a ruptured disk had been performed in this case two years prior to this x-ray film. Interpedicular measurement suggested a spinal cord tumor. This proved to be a caudal ependymoma at time of secondary laminectomy.

In eliciting the historical information referable to sensory impairments, one may find a patient describing a perfect sensory "saddle-type" of sensory loss from a complete annulus rupture which in the absence of a traumatic history may be suspected as a spinal cord tumor of the filum terminale. In general, the paresthesias of a ruptured disk are referable to one foot (fig. 1) and certain specified toes or foot areas of a transient character, while a tumor patient (fig. 2) is likely to describe a bilateral gluteal or pedal pattern that is persistent and progressive. The absence of any subjective impair-

ment of sensation excludes neither a disk nor a possible tumor. A complete annulus displacement into the lower lumbar spinal canal is likely to disrupt bladder and rectal sphincter control whereas sphincter dysfunctions in spinal cord tumors in this region develop

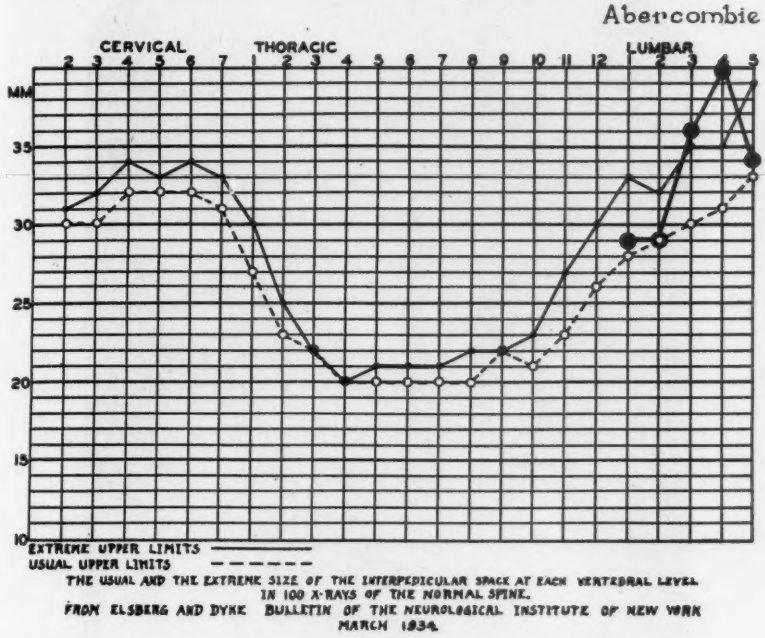


FIG. 6

late in the course of the disease, and usually appear after sensory and motor handicaps have developed.

Subjective motor handicaps are extremely infrequent in both tumors and disks. An acute complete rupture of a disk may precipitate a frank paralysis of dorsiflexion of the feet. A foot drop in a tumor case develops insiduously and is rather a latent manifestation of nerve root damage. Disk patients are more prone to notice a calf atrophy than are tumor cases.

Many of the disk patients notice a scoliotic list and describe it as a shortening of the painfully involved extremity. Other disk cases tell of a torsion of the pelvis with the painful hip becoming elevated. None of the spinal cord tumor cases describe a body or pelvic distortion. Unless there is true motor weakness the tumor patients do not relate a history of a limp, a very common complaint in ruptured intervertebral cartilages.

The objective neurologic symptomatology can be just as misleading clinically as the historical information obtained in these two types of cases. The frank absence of sensory, motor or reflex

Fig. 7. A rather characteristic contrast outline of a ruptured disk.

changes is likely to sway one's opinion in favor of a disk diagnosis whereas complete bilateral symmetrical sensory organic pattern is more in favor of a tumor diagnosis. Muscle spasm of the lumbar erecti groups is strikingly absent in our tumor series and a rather constant finding in the disk cases. The same observation is persistent in the destruction of the normal lumbar lordosis. A loss of the lumbar curve is not common in the tumor patients. Lateral listing is not characteristic of our tumor comparisons. When absent in the disk cases on erect posture this scoliosis is frequently elicited on forward bending, but in the tumor cases this maneuver did not bring out any abnormal positioning of the spines. A minor unilateral

measurable atrophy of a calf muscle group is more frequently found in the disk patient. Bilateral gluteal muscle fibrillations are more constant in the tumor lesions. Some feeble weakness in dorsiflexion

Fig. 8. Note the crescent domed deformity of the oil. This is a constant contrast radiologic defect in the benign cord tumors.

of the foot of the involved extremity is no rarity in the disk cases. Objective paralytic demonstrations are strikingly absent in the early tumor cases as well as in the unilateral cartilage ruptures. In an *acute* bilateral sciatica with bilateral dorsiflexor paralysis and an acute loss of vesical sphincter function, a ruptured annulus is a likely diagnosis. Fist percussion over the suspected tumor level may precipitate an exaggeration of radiating pain, but deep interspinal pressure tenderness is very rare. In the disk cases one of the most constant objective evidences is the maximal point of tenderness between the posterior spines at the involved intervertebral interspace.

In the full-blown tumor cases the sensory patterns as developed upon neurologic examination are exact and definite. In the earlier development of a tumor, no sensory objective changes of valuable localizing aid are obtained. Much more constant have been the minor sensory impairments and patterns in the disk cases. These

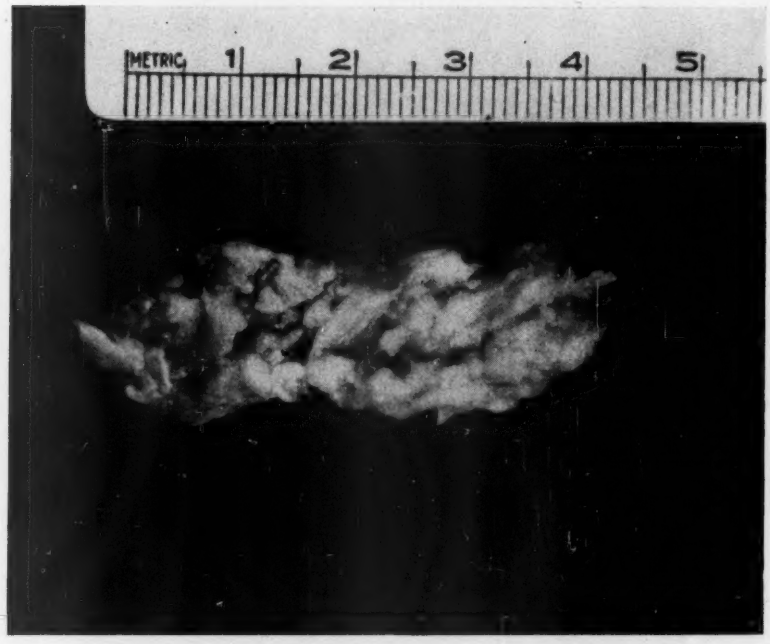


Fig. 9. An unusual annulus fragment which ruptured free into the lumbar canal producing bilateral sciatica.

have been diminutions in pain and touch appreciation confined to definite foot or toe spinal root distributions. In the tumors of the lumbosacral levels, gluteal patterns are more exact and definite whereas in the disk cases of these levels the sensory impairments are more consistently demonstrated in the more distal distributions of these sensory nerve innervations.

The investigative procedures undertaken in these cases have been those of x-ray of the lumbosacral vertebrae, spinal puncture with manometric determinations and fluid studies, contrast media visualization of the spinal canal and exploratory operations.

Routine x-ray films of the lumbar sacral vertebrae in disk cases may depict a narrowed intervertebral space on lateral positions. A destruction of the normal lumbar curve is more characteristic of a

ruptured cartilage above the lumbo-sacral level. A scoliosis (figs. 3 & 4) of the upper lumbar vertebrae contralateral to the involved extremity, is the more commonly abnormal roentgenologic depiction in the disk cases. A widening of the laminal pedicles (figs. 5 & 6) is to be seen in a few chronic spinal cord tumor cases. An enlargement of the normal nerve root foramen is to be seen in some of the

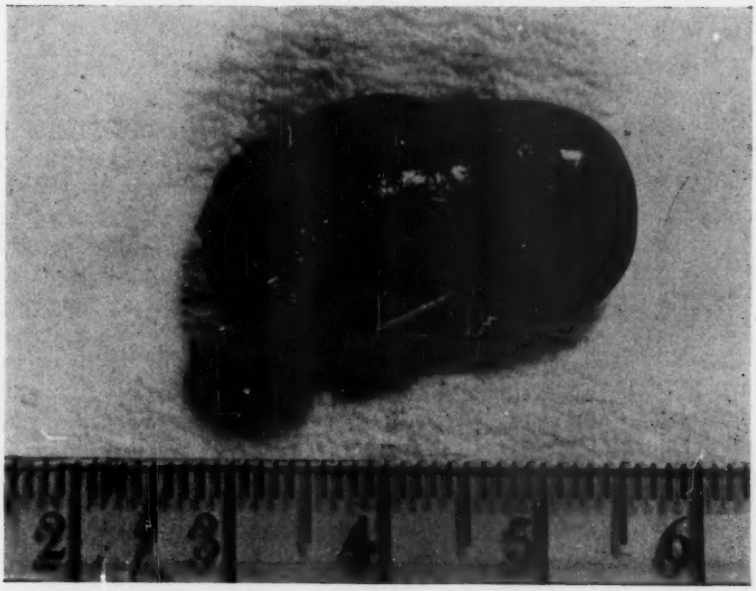


Fig. 10. A benign neurofibroma originating at 4th lumbar level masquerading as a ruptured disk.

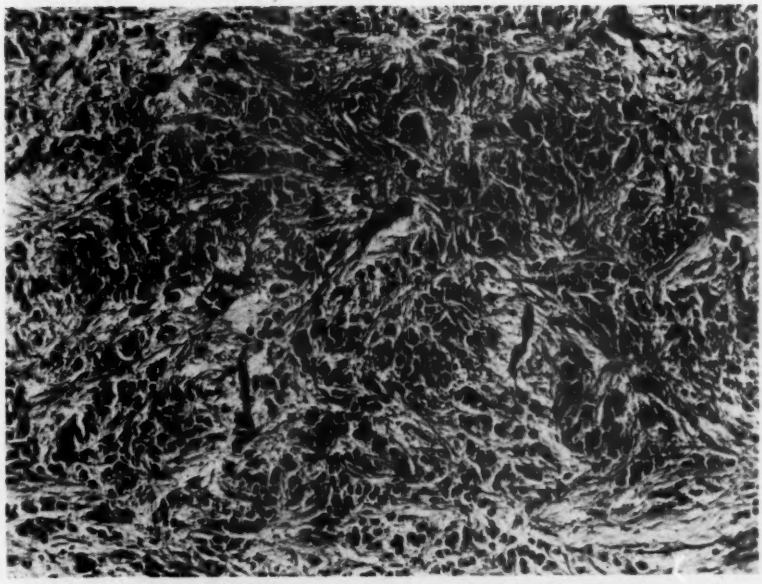
so-called dumbbell type of tumors of the spinal cord. In general, x-ray films of the vertebrae have been of greater value in the exclusion differential diagnosis of many of the other causes of low back and sciatic pain than of positive help in the diagnosis of disks or tumors within the lumbar canal. A normal x-ray of the lumbar vertebrae does not exclude a ruptured disk nor an interspinal growth. Contrast studies of the lumbar sacral sac using air, lipiodol (figs. 7 & 8) or pantopaque are invaluable in spinal cord tumors but there is a percentage of ruptured disks which escapes contrast outline, even with oil. This percentage is approximately double the percentage of negative surgical explorations if one establishes a rigid criteria for surgery.

There is no necessity for routine spinal puncture in perfectly clear-cut disk cases. In suspect tumor cases, spinal puncture is val-

uable in studying the patency of the spinal canal. If multiple punctures are resorted to or the puncture is consistently done below the level of the lesion, a complete block as demonstrated on manometric recordings and bilateral jugular compression is not a diagnostic differentiation between a tumor and a disk lesion. The converse of this situation also holds true. Spinal fluid examinations are of value insofar as that in the tumors a total protein of over one hundred milligrams per cent is quite a constant finding. In a complete obstruction of the spinal canal from a ruptured cartilage, the protein content may be high in excess of this percentage, serving as a confusion in establishing the diagnosis. Normal protein determinations are very frequent in our earlier disk experiences.

The one anatomic territory in which the neurosurgeon consistently functions most effectively in the operating room is in the spinal canal between the first lumbar and first sacral levels. However, as stated by Rasmussen, Kernohan and Adson, "The relative shortening of the cord incident to growth, and the emergence of the roots through the anterior foramena of the sacrum often make it extremely difficult to determine whether there is a tumor of the conus medullaries, of the canda equina, or the sacrum. The objective findings may be the same." It is here that contrast x-ray studies are most valuable. The greatest number of cartilage ruptures occur at the fourth-fifth lumbar and the fifth lumbar-first sacral levels. Properly diagnosed and selected cases can, upon removal of these ruptures (fig. 9) expect prompt relief. Residual motor or sphincter handicaps occur in less than one-half of one per cent of these cases. The spinal cord tumors (fig. 10) in this territory are in the greatest majority of instances of a benign character. The spinal cord has ended at higher levels so that the intrinsic gliomas of the cord are in a minority. Neurofibromas (fig. 11) arising from the nerve sheaths, meningiomas from the lumbar meninges, ependymonas (fig. 12) and tumors of blood vessel origin constitute the major groups in our series. All of these are demarcated growths, are operable and the immediate relief of pain is equally as dramatic as it is in the disk cases.

While back pain is common attendant of the disk picture, it is rare in spinal cord tumors of the lumbar area. It is of interest that back pain has persisted in approximately 15 per cent of the disk cases with a partial hemilaminectomy or with no laminal bony sacrifice, whereas it has constituted no handicap or disability in any of the tumor cases, where in some instances a complete entire lumbar laminectomy has been necessary for total tumor extirpation. This observation would suggest that the back pain of the disk case is



Figs. 11 & 12. Ependymomas and neurofibromas constitute the majority of lumbar spinal cord tumors in our series.

likely of joint origin and not primarily due to spinal nerve root damage.

From a review of personal diagnostic confusions and a comparison of symptoms both objective and subjective in certain cases of intraspinal tumors of the lumbar canal and cases of ruptured intervertebral cartilages, it is concluded that a clinical diagnosis can be made in a high percentage of instances, but there is a small number that so simulate each other that spinal fluid and contrast radiologic studies are necessary for complete diagnostic accuracy.

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TREATMENT OF ACUTE HEMATOGENOUS OSTEOMYELITIS

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THE availability of penicillin has altered the treatment, progress, prognosis and end results in many infections. Among these is acute hematogenous osteomyelitis. Unlike the sulfa preparations, undesirable reactions to penicillin are few and it can be used in large doses over long periods of time. Fortunately, it can be used in conjunction with the sulfa preparations without conflict.

With the advent of these agents, the medical treatment of acute hematogenous osteomyelitis is probably rewarded with better results than early surgical drainage. Penicillin acts by direct contact with the organism, as do the sulfa drugs, which makes it desirable in an area of hyperemia through which it can be disseminated. However, if a necrotic barrier is present, organisms probably will be safe from destruction, such as in the center of an abscess, especially in bones where increased blood supply is hampered by inability of the bone to swell. If, however, the penicillin is present in the early stages of infection, before necrosis takes place, or in an area where circulation is free, then it is usually master of the situation.

Sulfathiazole and sulfadiazine as adjuncts to penicillin must not be overlooked. Unfortunately, these at times are not well tolerated by some patients and must be discontinued. However, children usually tolerate them well and most acute hematogenous osteomyelitis is among children. It has been frequently found that one drug of the sulfa group will be tolerated well when others produce undesirable irritation, so that we have the advantage of several preparations to select from before discarding the sulfa drugs entirely. It is wise to give an alkali when one of these preparations is in use.

Acute hematogenous osteomyelitis is primarily a septicemia, with one or more secondary bone foci resulting. Septicemia in itself produces an acute illness and the osteomyelitis acts as a constant source of supply to maintain the toxemia by local bone and soft tissue destruction. Most hematogenous osteomyelitis is of either staphylococcic or streptococcic origin and, since penicillin and sulfathiazole act on each of these, the importance of determining which is the offending organism is minimal. Some clinics use staphylococcic

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toxoid to neutralize the toxemia in case of the staphylococcic infection. The toxoid is, however, neither bactericidal nor bacteriostatic.

The majority of acute hematogenous osteomyelitis is found in children above the age of 2 years; however, it is encountered at all ages. Since the disease is blood borne, the foci are nearly always deposited in the metaphyseal portions of the long bones. The disorder carries a very high mortality, reported from 20 to 40 per cent and in the past there has been a high incidence of crippling among survivors. Any child having the general signs of an infection and complaining of pain in any extremity, most often near a joint, should be treated for acute hematogenous osteomyelitis until the condition is proven otherwise. The bad results which follow a neglected case of osteomyelitis are so serious in pain, time, crippling and future expense that we are justified in overtreating the few cases of missed diagnosis to protect those who actually suffer from the disease. The time at which the best results are obtained is in the very early stages. The patient suffering from this disorder in the first 24 to 48 hours appears acutely ill. Usually a temperature of 102° or above is present, with rapid pulse and appearance of fatigue from pain and loss of sleep. The painful area is protected with great care by the patient and the adjacent joint is held fixed in the position of greatest comfort. At this stage of the illness, local redness and swelling usually are not present. However, firm pressure over the involved area produces much pain. The blood findings are a high total white cell count, with high percentage of polymorphonuclear leukocytes. Occasionally, the total white cell count is not above 10,000 but, in nearly all cases, there is a very rapid sedimentation rate. The red cells and hemoglobin are of extreme importance as a high level must be maintained during treatment. X-ray pictures at this stage of the disorder are of no value except perhaps for comparison with those taken later. No bone change is evident as it takes days, or perhaps weeks, for sufficient calcium absorption or bone destruction to take place to give visible x-ray findings.

Treatment, if begun early and if of sufficient intensity, should be rewarded with restoration to normal. The virulence of the invading organisms may be great or the organisms may be resistant to chemotherapy. In either case, treatment will be difficult and results doubtful. If the treatment is begun late, the outcome may be poor.

On admission to the hospital, the person is usually in pain and somewhat exhausted from the pain and loss of sleep. Sedation adequate to give rest and relief from pain should be administered at once and the patient should be kept pain-free as much as possible.

Fluids should be replaced as there has usually been loss of appetite, perhaps vomiting or diarrhea, in addition to the sweats that so frequently accompany such an infection. Intravenous drips of 5 per cent glucose and saline should be administered if sufficient food and fluids are not taken by mouth and retained, for high fever requires extra calories.

The involved extremity is not splinted but is allowed to rest in the position of greatest comfort. Constant warm, moist dressings are applied. Added heat from an electric pad or a hot water bottle will aid. Motion of the extremity should be encouraged. Splinting or traction is not needed in the early stages, as pathologic fractures are not likely to occur, nor are flexion deformities if motion is encouraged. Pathologic fractures usually take place only late, after days and weeks of bone infection and usually by that time, under this type of treatment, the disorder is under control.

Penicillin, 30,000 units, is administered intramuscularly every 3 hours day and night. This is frequently lowered to 20,000 or 10,000 units as the condition is brought under control. This treatment is usually sufficient, but as long as any agent is helpful, it should be used and, with this in mind, sulfathiazole or sulfadiazine, is also administered, 7½ to 15 gr. every 6 hours, depending on the size of the patient. A small amount of sodium bicarbonate is always given along with these drugs. Daily urinalysis is done, as long as a sulfa drug is being administered, to check on kidney irritation. Should this develop, of course the sulfa preparation is immediately discontinued, but the soda is used for 24 to 48 hours longer.

Close check on the hemoglobin is of great importance as there is sometimes a great drop in a very short period of time. Frequent small transfusions of 100 to 250 c.c. of blood are of inestimable value. These should be of sufficient frequency to maintain a normal hemoglobin and red cell level. Fever may persist for several days before it begins to drop gradually towards normal, but usually in 4 to 7 days it subsides and the patient feels greatly improved. In fact, he frequently feels perfectly all right. However, the penicillin should be continued 7 to 10 days after the patient is fever-free.

It has not been our policy to drain early cases of acute hematogenous osteomyelitis. Should an abscess develop, it may be aspirated with a large needle to relieve tension and give comfort. This is usually done after the patient has been under treatment for some time and is well saturated with penicillin and sulfa. Many patients will get by without cavity or sequestrum formation. If surgical drainage is necessary, a small incision is made at the most harmless

location. After the cavity is evacuated, a small amount of sulfa powder is dusted into the incision and the wound is closed tightly and a compression dressing applied. A drain is not inserted for fear of secondary infection. Usually one organism can be controlled more easily by chemotheraphy than perhaps many secondary invaders.

It is most important to keep the patient quiet and relatively inactive for some time after symptoms subside, as there is a tendency towards recurrence of the disorder even after the patient appears to be in excellent condition. It has frequently been found that although a patient has a normal blood count and appears to be completely recovered, the sedimentation rate will continue to be rapid. It has been our practice to use the sedimentation rate rather than the blood count as the index of the patient's progress. We feel that the sedimentation rate should remain within normal limits for some time before treatment is discontinued and activity permitted.

The patient should be observed for several months after treatment and, on the slightest sign of recurrence, the use of penicillin and sulfa drugs should be repeated. Frequently, although the infection is apparently well controlled, a sequestrum will develop after a few weeks. In this case, of course, the offending sequestrum should be removed, but it is best to wait until the patient has apparently completely recovered from all of the initial involvement before going in and removing the sequestrum. Penicillin should be administered 2 to 3 days in advance of surgery, as this will minimize the possibility of stirring up infection which may be present at the time of sequestrectomy.

It has been our custom to remove the dead bone, curet the cavity, dust it with a small amount of sulfanilimide powder and then close the wound tightly, continuing the use of penicillin and sulfa for a few days after surgery. In most instances, the wound will heal by primary union and drainage will not occur. X-rays taken at 3 to 4 week intervals reveal a gratifying rate of bone healing.

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CHOLELITHIASIS: MODERN PRINCIPLES OF THERAPY

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It is now generally conceded that when a diagnosis of cholelithiasis is made surgery is usually indicated as soon as the condition of the patient will permit, regardless of the severity of the symptoms. Marshall[1] states: "There is no such thing as harmless or silent gallstones." Cholecystitis, cholangitis, hepatitis, pancreatitis, and common duct obstruction can often be prevented by early surgical intervention. Acute cholecystitis rarely occurs in the absence of obstruction of the cystic duct by a stone. There is frequently evidence of stones having been in the gallbladder for some time in most cases of cholangitis and choledocholithiasis. Pancreatitis is often associated with infection and stones in the common duct.

In order that adequate therapy may be administered victims of gallstones, it is essential that the surgeon have a thorough knowledge of the anatomy and physiology of the biliary system and of the pathologic processes which may occur not only in the biliary tract of these patients, but also in extrabiliary systems: the renal apparatus, the gastrointestinal system, and the blood.

Cholelithiasis Without Jaundice

The problem which confronts the surgeon in cases of cholelithiasis without jaundice varies with the pathology. If the inflammatory changes are mild and there is little or no complicating hepatitis or pancreatitis the preoperative preparation differs little from that in other major surgical conditions. If, however, an inflammatory process has existed for some time as a result of gallstones, there may be definite hepatocellular damage and pancreatic changes. Varying degrees of anemia and a vitamin deficiency state may be evident. In acute cholecystitis there are often marked changes in the water and electrolyte balance. Cases with cholelithiasis require careful study, especially as relates to liver and renal function and blood chemistry.

The preoperative preparation should consist of restoring the liver function to as near a normal state as possible by giving glucose in adequate amounts, either by mouth or parenterally, correcting

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the anemia and vitamin deficiency state by blood transfusions and the administration of appropriate vitamins and diet, and restoring the water and electrolyte balance.

Cholelithiasis With Jaundice

Cholelithiasis with jaundice is one of the most serious of all surgical conditions and frequently taxes to the utmost the judgment and skill of the surgeon. In treating these patients, adequate laboratory facilities should be available for estimating the liver and renal function. The procedures commonly employed for this purpose are: The determination of the blood non-protein nitrogen, blood urea nitrogen, blood chlorides, prothrombin time, serum protein, serum bilirubin, hematocrit, quantitative van den Bergh, glucose tolerance test, stool examinations for urobilin. It is only by thorough and repeated study that patients so affected may be properly prepared for any necessary operative procedure.

The amount of liver and kidney damage and blood changes these patients have depends to a large extent upon the duration and degree of common duct obstruction and also on the severity of related inflammatory changes. Liver damage results in more or less loss of its detoxifying ability, may interfere with the formation of prothrombin, and decreases the metabolism of carbohydrates and proteins.

The hemorrhagic diathesis which occurs in obstructive jaundice is due to a decrease of prothrombin in the blood. While prothrombin is formed in the liver, it is seldom that the liver function is so reduced that this ability is greatly interfered with. If bile salts fail to enter the duodenum, fats and fat soluble vitamins are not absorbed. Since vitamin K is fat soluble and is necessary for the manufacture of prothrombin, complete obstruction of the common bile duct rapidly results in hypoprothrombinemia and a hemorrhagic tendency gradually develops.

The postoperative period in improperly prepared patients with obstructive jaundice is liable to be stormy. Acute liver and renal failure manifested by oliguria, elevation of the non-protein nitrogen, hypoglycemia, abdominal distention and hyperpyrexia may ensue and coma may develop. Once these alterations have been initiated, they may become irreversible and a fatal outcome result.

Since certain functions of the liver are dependent upon carbohydrates and proteins, it is essential that patients with obstructive jaundice, especially if it has existed for some time, be supplied with adequate amounts of these foods. In the absence of sufficient car-

bohydrates, fat is deposited in the liver and the function is further impaired. The diet, therefore, should be high in carbohydrates with a moderate amount of protein. Fats should be kept at a very low level. They are poorly tolerated and are not absorbed from

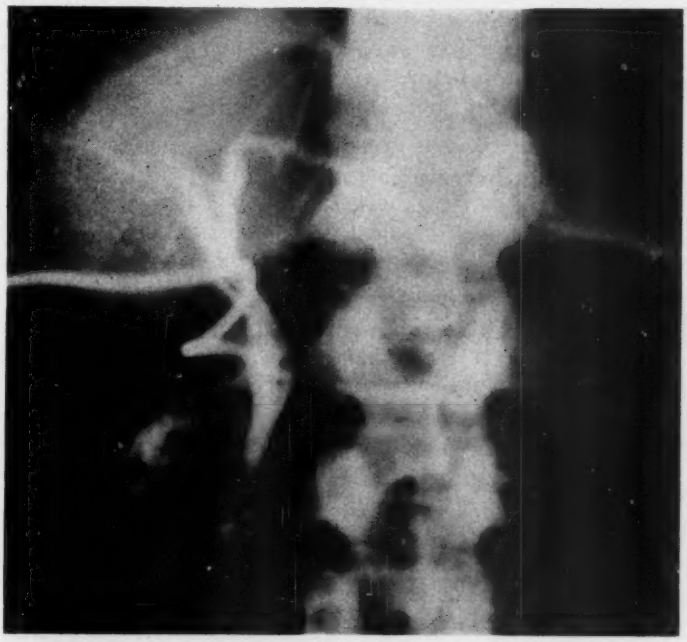

Fig. 1. Cholangiogram showing no evidence of duct obstruction.

the intestinal tract in the absence of bile salts; if they were absorbed their deposit in the liver would interfere with the formation and storage of glycogen.

If ingestion, digestion, or absorption of carbohydrates is interfered with to such an extent that an adequate amount is not obtained by the liver, glucose should be given parenterally. Since it is so important that sufficient carbohydrates be supplied it is usually advisable that glucose be given intravenously for a few days before operation regardless of the intake of carbohydrates by mouth. Proteins may also be given parenterally, in the form of amino acids, if the intake by mouth is inadequate.

The vitamin K deficiency may be corrected by giving this vitamin by mouth together with bile salts to facilitate its absorption, or synthetic vitamin K may be given parenterally. It has been proved

that bile salts may be very toxic;[2] therefore, some feel they should be given cautiously and sparingly in cases of obstructive jaundice. Vitamin K parenterally obviates the use of bile salts, permits precise dosage, and eliminates the variable factor of absorption. I have for some time used synthetic vitamin K parenterally and the prothrombin time has become elevated to a satisfactory level in a few days. As an extra precaution a transfusion of whole blood may be given immediately before operation. This aids in preventing hemorrhage and also corrects blood depletion to a certain extent.

In addition to the lack of fat soluble vitamins these patients may and frequently do have a deficiency of other essential vitamins, notably B and C. It is, therefore, advisable in the preoperative preparation to give these in adequate amounts. Postoperative complications as relates to wound healing, nausea, vomiting and abdominal distention may be minimized by this therapy.

Before any type of operation is undertaken on the jaundiced patient, water or electrolyte imbalance, hemoconcentrtaion or serum protein deficiency should be corrected. This can usually be effected by the parenteral administration of glucose in saline or distilled water, blood plasma, whole blood or amino acids, respectively.

Operation

Most operations for gallstones are fraught with danger, because many of the structures are deep in the abdomen and may be considerably altered by inflammatory changes. Irreparable damage may be done to important structures if every care is not taken. The most common misfortune is damage to the common duct during the performance of cholecystectomy.

Good relaxation and exposure are essential in biliary tract surgery. There is no anesthetic that will give relaxation equal to that of spinal anesthesia. I use this anesthetic unless there is some contraindication. Recently I have combined with it intravenous sodium pentothal. Only a sufficient amount of the latter for light anesthesia is given. This eliminates apprehension on the part of the patient and prevents vomiting and discomfort which might be caused by traction.

One of the most common causes of inadequate exposure is a short incision. All of the disadvantages, if there are any, of a moderately long incision are outweighed by the added ease with which exposure is obtained. The stomach and intestines must be held out of the way by large gauze packs. There are few operations in which a well trained assistant can be of more help in giving adequate exposure.

All structures must be definitely identified before they are clamped, cut or ligated. It is only by this means that injury to vital structures may be avoided. It is very important that hemorrhage be prevented. Attempting to clamp and ligate bleeding vessels in the region of the common duct may result in great damage.

In operations for gallstones the question as to whether or not the common bile duct should be opened and explored frequently

Fig. 2. Cholangiogram showing two retained stones in the ducts.

arises. This procedure is now being carried out much more frequently than formerly. Stones are often found in the common bile duct even when they were not suspected before operation. These patients frequently give no history of jaundice, intermittent fever, or any other symptoms suggestive of common duct pathology. Walters[3] reports that in 35 per cent of 200 consecutive cases in which stones had been removed from the common duct at the Mayo Clinic, it was found that there had been no evidence of jaundice at any time, and in 63 per cent fever had not been present. Cattell[4] states that, in a recent four year period, the common duct was ex-

plored in 48.8 per cent of the patients operated upon for gallbladder disease at the Lahey Clinic, and that common duct stones were found in 14.1 per cent of all patients operated upon for gallbladder disease.

In the hands of a competent surgeon exploration of the common duct adds little or nothing to the risk of the operation. An elevated serum bilirubin, whether the patient has clinical or subclinical jaundice, is a definite indication for exploring the duct. This is also true if the presence of a stone is suggested on palpation of the duct. Exploration of the duct is also indicated if it is dilated or thickened or if small stones are found in the gallbladder in the presence of a large cystic duct. Acute cholecystitis, per se, does not preclude exploration of the common duct if indicated.

Postoperative Treatment

In patients who have had adequate preoperative preparation the postoperative treatment is usually simple. As in all surgical cases it is important that the water and electrolyte balance be maintained. In patients with jaundice an adequate prothrombin level must be assured until it is certain that sufficient bile is entering the duodenum and vitamins are being taken by mouth. Abdominal distention, wound disruption and other postoperative complications may be obviated by the early correction of low serum protein, which may be encountered postoperatively.

Patients with a tube draining the common bile duct present an additional problem: when should the tube be removed? This depends to a great extent on the pathology found at operation. In the presence of marked hepatitis, pancreatitis or cholangitis, it is advisable to leave the tube in place for weeks or months. It should be left until one is assured that inflammatory changes have subsided sufficiently so there will be no interference with the flow of bile into the duodenum. If little or no evidence of inflammation is found at operation and no stones are encountered the tube may be removed relatively early. Even after a thorough exploration of the common duct a stone may not be found. It may have been overlooked at operation or may possibly have subsequently passed down from one of the intrahepatic ducts. It is, therefore, very important that obstruction to the duct be ruled out before the tube is removed. The evidence of bile in the stool, and the absence of discomfort and leakage of bile around the tube on prolonged clamping are fairly reliable tests for common duct patency. If there is reason to suspect obstruction, cholangiography should be resorted to before the T-tube is removed. I have recently been making cholangiograms

in all cases in which stones were found in the common duct at operation. In the absence of obstruction the patient experiences no discomfort when the contrast medium is injected through the T-tube. The x-ray film shows radiopaque material in the duodenum, the bile ducts do not appear dilated, and no filling defects are noted in any of the ducts. Lipiodol, brominal and diadrast are contrast media commonly employed in cholangiography. I have found diadrast in a 25 per cent solution very satisfactory.

A stone found in the common duct with the T-tube still in place can occasionally be removed by the injection of a few cubic centimeters of ether or a mixture of ether and alcohol into the common duct, together with the administration of nitroglycerine to relax the sphincter of Oddi as described by Walters.[5] Recently Goldman, Jackman and Eastmen[6] have reported the successful removal of gallstones from the common duct by injecting large amounts of a solution of citric acid, magnesium oxide and sodium carbonate through the T-tube. I have used Walters' method with success.

Symptoms such as dyspepsia, upper right quadrant pain or jaundice may follow operations for gallstones. Stones left in the common duct, or which subsequently pass into this duct from one of the hepatic ducts, are the most common cause of these symptoms. Retained common duct stones rarely pass into the duodenum on account of the tone of the sphincter of Oddi; thus spontaneous recovery is rare.

Injury to the common duct resulting in stricture is a too frequent cause of postoperative symptoms. Damage to the common duct can usually be suspected early if there is profuse, prolonged drainage of bile from the incision following cholecystectomy.

Inflammatory changes in the liver, bile ducts, and pancreas may persist for some time following operations and may cause the patient considerable discomfort. Symptoms due to these inflammatory conditions may usually be obviated if the pathology is recognized and appreciated at the time of the operation and the T-tube left in a sufficient length of time.

Occasionally following cholecystectomy the patient experiences mild attacks of biliary colic which may persist for a few weeks and gradually subside. It is thought that this may be due to a gradual dilatation of the bile ducts or a temporary increased tone of the sphincter of Oddi.

In rare instances postoperative attacks of pain persist and none of the usual causes can be found at re-operation. These paroxysms of pain may be due to spasm of the sphincter of Oddi, which has

been termed "biliary dyskinesia." A thorough dilatation of the sphincter of Oddi at the time of operation may prevent this condition.

Summary

1. The importance of early surgery to prevent complications in patients with gallstones is stressed.

2. The problem confronting the surgeon in cases of cholelithiasis without jaundice may be small or great depending upon the pathology. Extensive inflammatory changes in the gallbladder, bile ducts, liver or pancreas call for careful preoperative preparation.

3. Cholelithiasis with jaundice may result in marked liver and kidney damage as indicated by abnormalities in blood vitamin deficiency state and alterations in the water and electrolyte balance. It is very important before any operative procedure is carried out that these various changes be corrected as nearly as possible by the administration of appropriate vitamins, blood transfusions, glucose and saline and a special diet.

4. Any operative procedure for cholelithiasis must be carried out with great care because of the danger of damage to important structures. Adequate exposure, facilitated by good relaxation, long incision and well trained assistants, is essential.

5. The indications for exploring the common bile duct are as follows:

(1) History of jaundice.

(2) Elevated serum bilirubin.

(3) Suggestion of stone on palpation of the duct.

(4) Dilated or thickened duct.

(5) Small stones in the gallbladder, especially in the presence of a large cystic duct.

6. The time of removal of T-tube is determined by the pathology found at operation, the effect of prolonged clamping of the T-tube, and the results of cholangiography.

7. Digestive symptoms, upper right quadrant pain, or jaundice following operations for gallstones may be the result of stones overlooked in the common duct or stones which have subsequently passed into the common duct from the intrahepatic ducts; stricture resulting from injury to the common duct; residual inflammatory changes in the liver, bile ducts or pancreas; gradual dilatation of the bile ducts; and spasm of the sphincter of Oddi.

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CHARLES JEFFERSON MILLER—HIS TEACHINGS IN THE THERAPY OF PUERPERAL SEPSIS

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THE STRONG note of conservatism in the management of abortions (whether septic or not) and puerperal sepsis found in the Departments of Gynecology and Obstetrics at the Tulane University School of Medicine and its allied services echoes the dictums set forth many years ago by Dr. Charles Jefferson Miller. His teaching, wisdom, manner, honesty and foresight had a profound influence not only on our present day concept of the management of these cases but also on the decisions of many of us to pursue gynecology and obstetrics as a specialty.

My first contact with Dr. Miller was as a junior medical student in 1926. His impressive lectures always occasioned a full attendance by the student body. One statement regarding septic abortion and puerperal sepsis, which he emphasized at that time and which is still stressed in the department by all its members, is: "We should teach midwives and doctors that the uterine cavity should not be invaded twice within a seven day period." Today, as in that day, there are a certain number of midwives and physicians who will perform illegal abortions, and, today, as in that day, we still believe that the uterus should not be emptied prematurely unless there is a definite medical indication for it. Nevertheless, despite the threat of legal punishment, criminal abortions will still be practiced by a number of people. It should be emphasized to all midwives and physicians during their period of training that infection can be and is introduced into the uterus, especially the pregnant uterus, and that the majority of uteri will take care of it adequately since the infection is limited at this time to the endometrium. They should also be told that a second invasion of the uterine cavity within 2 to 7 days following the first will usually disseminate the infection into the lymphatic or blood stream with resulting postabortal or puerperal sepsis. The usual story in infected cases of abortion is that a therapeutic or illegal abortion is attempted, usually by packing of the uterus or insertion of a catheter. There is no result forthcoming within 24 to 48 hours and the patient and abortionist both become frantic. As a consequence, a second attempt is made to empty

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the uterus and the uterine cavity is again invaded. It is during this second invasion that the infection is usually disseminated. Whether the abortion has been completed or not, the patient usually begins to run fever. If she is fortunate, the infection will remain primarily confined to the lymphatics and a parametritis, or an ovarian abscess or a true pelvic abscess will develop. If she is less fortunate, the infection will gain access to the ovarian veins or uterine veins and then spread to the hypogastric and common iliac veins to produce severe thrombophlebitis. The same condition exists just before term or at term in the patient who, because of prolonged labor, has had more than the average number of vaginal examinations, conducted either under strict aseptic conditions or in a helter skelter manner, and in whom the pregnancy has been terminated by operative delivery performed either vaginally or abdominally. An identical picture is found in the patient who has a normal pregnancy and a spontaneous or operative delivery, but in whom the impatient obstetrician performs early or routine manual removal of a placenta, whether retained or not. In all of these clinical conditions, whether the infection follows a criminal or spontaneous abortion, a spontaneous or operative delivery, the puerperal complication is initiated by repeated invasion of the pregnant uterine cavity.

What do we mean by strict conservatism in the management of puerperal and postabortal sepsis? Before the advent of the sulfonamides and penicillin, incomplete abortion, septic abortion and puerperal sepsis were handled in the following manner. The patients, placed at absolute rest in a light, airy room, were given morphine, codeine or other sedatives sufficient to obtain the desired freedom from pain. A high caloric, low residue diet and a fluid intake of 3000 c.c. daily were maintained. Small, multiple blood transfusions of 200 to 300 c.c. a day, or every other day, were given for anemia or continued high fever. An initial speculum examination was done under sterile conditions and any foreign bodies, catheters, or packs were removed from the vagina or cervix. No attempt was made to enter the uterine cavity, either to pack it with gauze or other material, or to curet the uterus to remove those remnants of conception still present. Any products of pregnancy appearing at the external os were removed by means of sponge forceps, but under no circumstance was the cavity of the uterus invaded. Pituitrin and ergot were given in an attempt to maintain firm contraction of the uterus and if these two simple measures did not control any hemorrhage that might be present, then recourse was had to packing, not of the uterine cavity, but of the vagina only. This was best accomplished by placing the patient in the Sim's position, removing all blood clots from the vagina and then packing it tightly with cotton balls wrung

out in a sterile solution of boric acid. The patient's general health was maintained by infusion and transfusion. Vitamins were utilized as a general supportive measure. No other therapy was used. Vaginal examination was performed usually at about weekly intervals. If any evidence of abscess formation was found, the abscess was promptly drained. If it pointed to the cul-de-sac, it was drained per vaginum; if it appeared in one or the other of the broad ligaments, it was preferably drained extraperitoneally in the inguinal region. Needless to say, some of these patients did not get well, but there was little more that could be done for them and it was our experience that any attempt to curet a uterus in the presence of fever greatly increased the incidence of complications and the mortality rate.[1]

During my period of residency under Dr. C. Jeff Miller I often heard him make the statement, "New surgical technics and operations will be less frequently encountered in the future; the biggest advances in medicine are going to be in biochemistry." The developments in the field of chemistry of the vitamins, the hormones, the sulfonamides and penicillin have certainly fulfilled this prophecy. With the advent of sulfa drugs the mortality and morbidity rates in puerperal and postabortal sepsis on our service have been materially lowered. In 1937, 491 cases of abortion were treated on the Tulane Service at Charity Hospital in New Orleans with a mortality rate of 1.4 per cent, whereas in 1941 there were 369 cases with a mortality rate of 0.5 per cent.[2] The low figure obtained in 1941 was definitely made possible by the addition of chemotherapy to our previous conservative regimen. Only future studies will determine whether penicillin will further reduce the mortality rate. Despite all these measures there are cases which terminate fatally, particularly those in which puerperal or postabortal thrombophlebitis has developed.

The diagnosis of pelvic thrombophlebitis is made by the exclusion of other clinical conditions causing chills and fever, as pyelitis or malaria, and a history of pregnancy followed by chills, fever and the finding on vaginal examination of little or no exudate in the region of the broad ligaments. Occasionally, a worm-like mass of thrombosed veins in one or the other fornix may be found. In cases of pelvic thrombophlebitis Dr. Jeff Miller would at times perform a laporotomy and ligate one or both ovarian veins,[3,4] dependent on whether a thrombus was found in one or both. Only the vein in which the thrombus was encountered was ligated. Operation was not performed immediately. Dr. Miller always said, "It is perhaps better to wait a little while before ligating the ovarian vein to give the patient time to vaccinate herself against some of the organisms."

We believe that this delay might, in part, explain some of the unsuccessful results. However, Dr. Miller was correct in the idea that if conservative measures fail, operation should be performed. Today, we feel that if conservative measures, including adequate dosages of the sulfonamides and penicillin, fail, operation should be performed early in every case, and immediately if pulmonary infarction occurs.

What were the results in the cases in which ovarian ligation was performed? In the days before chemotherapy the average mortality rate of puerperal pyemia was between 60 and 70 per cent. On Williams' service, 66 2/3 per cent of the patients died, whereas with vein ligation the gross mortality rate was 43.9 per cent.[5] Although there was some reduction, there was not enough to settle the issue as to whether or not operation was ever indicated in the management of puerperal or postabortal thrombophlebitis.

Dr. Jeff Miller often "wondered whether or not he was doing these patients any good." In the light of past experience I believe he did save a number of lives. Abdominal operation for the treatment of puerperal sepsis at first thought seems extremely radical and would not appear to fit in with the conservative regimen so prevalent on the Tulane Service. However, again to quote Dr. C. Jeff Miller, "There are times when being conservative is being very radical and when being apparently radical is really being conservative." If one persists in the conservative management of puerperal or postabortal thrombophlebitis or sepsis despite lack of improvement and especially if the patient has a pulmonary infarct, in the terms of Dr. C. Jeff Miller's dictum he is being radical, not conservative. We have through the years shared in Dr. Miller's enthusiasm when venous ligation in puerperal sepsis for thrombophlebitis was successful and in his depression when the procedure failed. When successful, we thought that the problem was solved, but when the patient failed to improve after an ovarian vein was ligated, we wondered if the patient would have been better off without operation.

On Feb. 14, 1942, I[6] was called to Charity Hospital in New Orleans to see a postpartal patient having chills and fever in whom the radiographic diagnosis was tuberculous bronchopneumonia. Examination of the pelvis revealed wormlike masses of veins in the right parametrial area; the diagnosis of puerperal sepsis with pelvic thrombophlebitis and multiple infarction of the lung was made. It was decided to ligate the thrombosed ovarian vein. The abdomen was opened and the ovarian veins were ligated, as thrombi were found in both veins, but in addition both common iliac veins were

thrombophlebitic. With some hesitation the vena cava was ligated above the thrombus at the level of the fourth lumbar vertebra. Postoperatively, the patient had bilateral lumbar sympathetic blocks daily in order to improve any circulatory disturbance that might have been occasioned by ligating the vena cava. Much to our surprise within 10 days the patient's temperature was normal and within 15 days her lungs had cleared. Only a small amount of edema, with a fairly high venous pressure, was found in the legs. It then occurred to us that perhaps the previous operative failure in the treatment of pelvic thrombophlebitis was due to the fact that only the ovarian veins were ligated and perhaps the results could be improved if the normal venous return from the uterus were occluded. We therefore decided that in future cases, if the patient did not improve under a conservative regimen and if there was infarction to the lung, we would ligate not only the ovarian veins but the vena cava as well. Since that time we have performed ligation of both ovarian veins and the vena cava in 12 of these cases. All except 3 of these patients are well today. Two of these three survived operation for 2 years, only to die of other causes. One died during a thoracic operation for relief of an unresolved pulmonary abscess which dated from the original infarction at the time of puerperal sepsis. The second death occurred 2 years after the operation from Herxheimer's reaction following a dose of salvarsan. The other patient died the day of the operation. Four hours after her admission to Charity Hospital I operated on this patient despite clinical signs of peritonitis and pelvic thrombophlebitis. At operation generalized peritonitis was encountered and the thrombus in the left ovarian vein was found to extend into the renal vein. At autopsy the thrombus extended through the vena cava and into the auricle of the heart. We might be criticized for operating in this case, but we believe that the operation should be performed in all cases in which a life might be saved. The survival rate in these 12 cases is 83 per cent, the mortality being uncorrected. During my 3½ years in military service there were other cases of thrombophlebitis of the pelvis treated by ligation of the ovarian vein and vena cava by members of the department at Tulane University and the statistical results have remained the same. An analysis of this total series of cases will be presented in another paper.

What is the future course of patients in whom the ovarian vein and vena cava have been ligated? Studies show that the venous pressure immediately after operation is elevated anywhere from 200 to 600 mm. of water. Burch[7] has published his findings in 5 of these patients examined 10 months following the operation. This investigation comprised a study of the venous pressure, the rate of

water loss of the skin and the volume pulsation in the peripheral blood vessels. He found the venous pressure greatly increased in the veins of the dorsum of the foot. The rate of water loss of the skin, of the tip of the right second toe and of the pretibial area was normal by the eighth postoperative day. The volume of pulsations of peripheral blood vessels was greatly decreased, but he concluded "All patients showed remarkably good compensation of the circulation following ligation." Edema is minimal, so little in fact that it is very difficult to distinguish the patient who has had ligation of the vena cava from any other patient. We believe that this lack of edema is due to the fact that in our earlier cases we routinely blocked the lumbar sympathetic chain bilaterally for 5 to 6 days following operation. In my last 3 cases I sectioned the right and left lumbar sympathetic chains at the time of ligation of the vena cava and ovarian vein; this has eliminated the necessity for doing postoperative lumbar sympathetic block.

As regards collateral circulation, do large abdominal and thoracic veins develop in these patients? In the cases we have had there has not been any increase in the size of the veins in the leg, the abdomen or the costal area. I have had occasion to perform a hysterectomy for fibroids on one of the patients in whom I had ligated the vena cava and ovarian veins 4 months before. At the time of operation circulation in the anterior abdominal wall and in the pelvis was carefully studied. There was no increase in size of the superficial epigastric vessels or preperitoneal vessels or in any of the pelvic vessels which could be identified at operation. The return flow of blood is largely through the vertebral and lumbar veins. Therefore, in the light of our experience in these cases we recommend ligation of both ovarian veins and the vena cava for the therapy of puerperal or postabortal thrombophlebitis in which conservative measures, including adequate dosage of sulfa drugs and of penicillin, fail to produce improvement in the patient's condition. This procedure is urged in cases with pulmonary infarction during the course of therapy whether or not conservative measures are producing improvement.

In conclusion, the members of the Gynecologic Staff at Tulane University have seen no reason to deviate from the conservative management of puerperal and postabortal sepsis so thoroughly imbued in us by Dr. C. Jeff Miller. The constant year by year lowering of the mortality and morbidity rates on our service, now that we have sulfa drugs and penicillin and operative procedures which are helpful when non-operative measures have failed, has justified our continuation of the conservative dictums set down by our pre-

ceptor. Perhaps the day is not far distant when there will be available new sulfonamide derivatives or new antibiotics of such potency and such specificity as to render operative procedures in the treatment of puerperal or postabortal sepsis absolutely unnecessary. We hope some day to be able to report not on how many cases of postabortal or puerperal sepsis we have treated, not on how many have had operations, but on the fact that these two conditions are no longer encountered on our service.

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PROPHYLAXIS OF MAMMARY CARCINOMA

Cancer phobia is becoming much more prevalent. At least half of those with suspected breast lesions are suffering from it. This is good and, at the same time, bad. The laity has been, and is being, educated to realize the danger of lumps in the breast or of abnormal discharges from the nipples. There are three other conditions, however, which should be borne in mind when one considers prevention of cancer of the breast; namely, lactation, support, and abnormal involution.

Lactation is a normal physiologic sequel to parturition. The breasts were put on the woman for the purpose of secreting milk, and not to serve as a secondary sex asset to attract the opposite sex. If they carry out their normal function, cancer is much less likely to develop. Witness the cow—she breeds and gives milk, then breeds again and continues to give milk, and rarely, if ever, has cancer of the udder.

Not only is the mother benefited by nursing the child, but, as a rule, the child will be better with the food provided by nature than on a formula. It is recognized that it is frequently necessary to wean a baby, and then, of course, it should be weaned, the lactation terminated, and the pediatrician consulted. All too frequently, though, this is done for the convenience of either the mother or the doctor and, in this case, should not be tolerated. Pediatricians should realize that the premature termination of lactation very

likely leaves that person more susceptible to a carcinoma than one whose breasts have lactated normally.

Man was created for quadripedal life, but in the evolution to a bipedal existence, he has become more likely to develop certain abnormal conditions—among these are hernias, varicosities, and hemorrhoids. It is not generally recognized that the breast also suffers from an upright posture.

At least eight out of every ten pathologic lesions in the breast, especially carcinomas, occur in the upper outer quadrant. There must be some reason for this. Could it be that the pendulous breast has its circulation interfered with in the upper half, while that of an animal on four legs enjoys free and uninhibited circulation? If this is true, proper support of the breasts without constriction is one of the best means of preventing cancer. Unfortunately, when those who are now in the so-called cancer age group were young, it was a disgrace for a boy to know that a girl had a breast, and, as a consequence, they wore very tight garments to conceal a well developed breast. This served further to break down the supporting ligaments already overburdened by the heavy breasts. These now, because of their constant discomfort and fear of cancer, are among the most distressing cases confronting the mammalogist. By popularizing the breast, Mae West has unconsciously, but undoubtedly, done much to reduce the incidence of malignancy.

Everyone recognizes the rather close relationship between the ovaries and the breasts, and the changes which take place in the breast at ovulation. Normally, these should regress at menstruation. Failure to do so produces the all too frequent, and annoying, and poorly named "mastitis," much better called "abnormal involution." Premature or artificial termination of a lactation results in a pathologic, instead of a physiologic, involution. It, of necessity, renders that breast more likely to develop a carcinoma.

Oncologists are not agreed that these mastopathias are precancerous. The late Dr. James Ewing once said if we could do away with stagnation in the breast, we would largely eliminate carcinoma of the breast. Bagg and Adair at the Memorial Hospital in New York showed that ligation of the mammary ducts of the breasts of one side of a mouse or rat, and subsequently allowing this animal to breed, would produce carcinomas on the ligated side and not on the other. The routine use of a breast pump is therefore frequently as important as that of the toothbrush! We help nature by brushing our teeth at least twice daily, by taking a bath when dirty, by taking a laxative when constipated, so why not help pre-

vent stagnation in the breasts by using a breast pump? And, if its use is preceded by hot applications, the results will be much more satisfactory.

The mastopathias present a more baffling and serious problem. No panacea has been found for them. Many clear up or are greatly improved by the restrained use of estrogens, together with heat, the breast pump, and adequate support. Intractable cases, as well as the more extensive ones occurring in the older age groups, require more radical treatment, even to bilateral simple mastectomies.

Let the intelligent woman be informed, then, that if she bears a child and nurses it, she will be less likely to have a cancer, that she should secure adequate, but not constrictive support of the breasts, and that if she has the so-called mastitis, she should have her breasts examined frequently, and if near the menopause, and the disease is extensive, a simple mastectomy is a conservative measure.

WM. PERRIN NICOLSON, M. D.

The Alabama Sight Conservation Association has recently donated $10,000 to the Department of Ophthalmology of the Medical College of Alabama, to provide equipment for the University Eye Clinic. The Alabama Sight Conservation Association was originated and is sponsored by the Lions Clubs of Alabama.

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

MEDICAL BIOCHEMISTRY. By MARK EVERETT, Ph.D., University of Oklahoma School of Medicine, Ed. 2, 767 pages, with 106 tables, 9 figures and a bibliography at the end of each chapter. Price, $7.00. New York, 1946, Paul B. Hoeber, Inc.

This book was originally one of the Medical Students' Series but it has been revised to include modern information. Several topics were expanded and the new subjects include adaptive enzymes, amino acid therapy, antibiotic substances, bacterial polysaccharide haptens and turnover numbers of enzymes. The general plan of correlation of the subject-matter with clinical medicine is continued.

A new index has been added and the book is enlarged by 73 pages.

With the exception of the chapters on digestion, vitamins and hormones, each chapter is divided into sections on chemistry, metabolism and pathology.

The organization and presentation are based upon more than twenty years of active consultations with clinicians and study of teaching problems. The book should not only be a valuable text for medical biochemistry courses but it should be a handy reference volume for the practitioner.

E. B. C.